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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Enamul Haque, et al.

Group Art Unit: 1732

Examiner: Unknown

Serial No.: 10/688,013
(Publication No. 2005/0082721)
4/21/05

Filed: October 17, 2003

For: Development Of Thermoplastic Composites Using Wet Use Chopped Strand (WUCS)

Attorney Docket No.:

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GREGORY MILLS
QUALITY ASSURANCE SPECIALIST

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Respectfully submitted,

By: 

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Date:

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I certify that I served:

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on June 17, 2005 by mailing (via First-Class mail)

a copy to:

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I declare that the statements above are true to the best of my information, knowledge, and belief.

Date: 6/17/05

Donald E. Bullock

PTO/SB/08A (10-96) [MODIFIED]
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Substitute for Form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	10/688,013
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First Named Inventor	Enamul Haque
Group Art Unit	1732
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Attorney Docket Number	25371 A

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Examiner Initials*	Cite No.[1]	U.S. PATENT DOCUMENT Number		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
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[1] Unique citation designation number. [2] See attached Kinds of U.S. Patent Documents. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet	2	of	2

Complete if Known	
Application Number	10/688,013
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First Named Inventor	Enamul Haque
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OTHER PRIOR ART -- NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		Enquireply archives, May 1999, Week 5 (#269), page 1 of 1; peach.ease.lsoft.com; The Electronic Commerce Korea (EC Korea) Harmonized Code: 70-7020 Glass & Glassware.	

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[1]Unique citation designation number. [2]Applicant is to place a check mark here if English language Translation is attached.

United States Patent [19]

Brown et al.

[11] **4,394,414**

[45] **Jul. 19, 1983**

[54] **AQUEOUS SIZING COMPOSITION FOR GLASS FIBERS FOR USE ON CHOPPED GLASS FIBERS**

[75] Inventors: **Daniel G. Brown, Caroleen; Donald L. Motsinger, Forest City, both of N.C.**

[73] Assignee: **PPG Industries, Inc., Pittsburgh, Pa.**

[21] Appl. No.: **268,541**

[22] Filed: **May 29, 1981**

[51] Int. Cl.³ **D04H 1/58; C08L 83/06**

[52] U.S. Cl. **428/288; 65/3.41; 428/290; 428/391; 428/392; 523/208; 523/209; 524/211; 524/105; 524/588**

[58] Field of Search 524/588, 211, 105; 428/378, 391, 290, 288, 392; 65/3.41; 523/209, 208; 106/287.1, 287.13, 287.16

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Product Information, Information About Silicone Emulsions, Dow Corning Corporation.

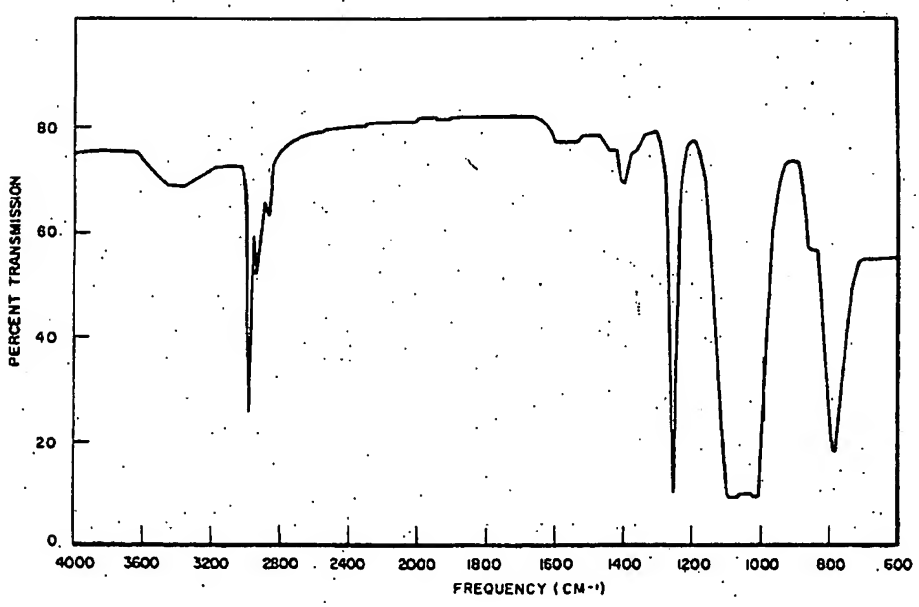
Primary Examiner—Theodore E. Pertilla

Attorney, Agent, or Firm—Kenneth J. Stachel

[57] **ABSTRACT**

An aqueous sizing composition having a cationic lubricant, amide compound, and cationic silicone polymer aqueous emulsion which is used to produce wet chopped sized glass fiber strands or which also has a film former to produce continuous glass fiber strands. The moisture content of the wet chopped glass fiber strands is controlled to within about 9 to about 20 weight percent. The sized wet chopped glass fiber strands have good flowability and when used to produce non-woven glass fiber strand mat, produces mat with good flexibility and tensile strength.

21 Claims, 1 Drawing Figure



AQUEOUS SIZING COMPOSITION FOR GLASS FIBERS FOR USE ON CHOPPED GLASS FIBERS

The present invention is directed to an aqueous sizing composition for treating glass fibers and to a method for forming treated glass fibers and to the treated glass fibers and to mat of treated glass fibers, where the treated glass fibers have good flow characteristics for use in bulk handling systems, and where the treated glass fibers are to be used to produce a non-woven mat having good flexibility.

The production of glass fibers from molten glass involves attenuating fibers from small orifices in a bushing in a glass melting furnace. As the glass fibers are attenuated, but usually before they are gathered into one or more strands, an aqueous sizing composition is applied to them. The aqueous sizing composition is necessary to provide protection to the fibers from interfilament abrasion. Also, the sizing composition can be used to promote compatibility between the glass fibers and any matrix in which the glass fibers are to be used for reinforcement purposes. In the production of glass fibers, after the sizing is applied, the fibers can be gathered into one or more strands and wound into a package or chopped while wet and collected. The collected continuous strands or chopped strands can then be dried or the wet chopped strands can be packaged in their wet condition. Such steps depend upon the ultimate use of the glass fibers. The dried continuous glass fibers can be subsequently chopped or combined with other glass fiber strands to form a roving or produced into continuous strand mats or woven.

Another characteristic that is sought not in the non-woven mat itself, but in chopped glass fiber strands and especially wet chopped strands used to make the mat or any other use to which chopped glass fiber strands are put is good flowability of the chopped strands. This good flowability is especially important when the chopped strands are to be handled by bulk handling machinery in producing glass fiber strand products such as non-woven mat or reinforced gypsum and cementitious products.

It is an object of the present invention to provide an aqueous sizing composition for glass fibers that are manufactured by the wet chopped forming processing to yield wet chopped glass fiber strands having good flowability especially in bulk handling machinery.

It is a further object of the present invention to provide wet chopped glass fiber strands that have good flowability in bulk handling machinery.

It is another further object of the present invention to provide an aqueous sizing composition for treating glass fibers in any forming process that allows for the production of non-woven glass fiber strand mat having good flexibility. It is another additional object of the present invention to provide a more flexible non-woven glass fiber strand mat.

The method of producing flowable chopped glass fiber strands that are chopped during forming involves attentuating glass fibers from molten cones of glass from a bushing, sizing the glass fibers with an aqueous sizing composition to control the moisture content of the chopped glass fiber strands within the range of about 10 to about 20 weight percent, gathering the fibers into one or more strands and chopping the glass fiber strands to produce wet chopped glass fiber strands.

The treated glass fiber strands can be used to reinforce materials such as calcium sulfate dihydrate (gypsum) and other such calcium compound products such as cementitious products. Also, the treated glass fiber strands can be used to produce a non-woven glass fiber strand mat by any process similar to the "wet laid" process on any type of suitable machinery to produce a more flexible non-woven glass fiber strand mat.

In accordance with the present invention, the flowability of the wet chopped glass fiber strand is achieved only when the chopped glass fibers have been produced by a wet chop glass fiber forming process. The production of a flexible mat of glass fiber strand is achieved by wet or dry chopped glass fiber strand produced by the present invention.

The aqueous sizing composition with at least the cationic lubricant, cationic curable silicone polymer emulsion and amide compound, is applied to the glass fibers in a wet chop forming process. Such a forming process involves supplying a plurality of streams of molten glass, attenuating the streams into filaments, applying an aqueous sizing composition to control the moisture of the resulting chopped glass fiber strands to a moisture level in the range of at least about 9 to about 20 weight percent of the chopped glass fiber strand, and cutting the continuous filaments into discrete segments. The glass fibers can be cut as individual fibers or they can be gathered into one or more strands and subsequently cut. The cut glass fibers or glass fiber strands then are collected as wet chopped glass fiber strands. Any other suitable wet chopped glass fiber forming process can be used when the aqueous sizing composition of the present invention is applied to the glass fibers. The control of the moisture content between the range of at least 9 and 20 and preferably 9 to 15 weight percent is crucial for the flowability of the wet chopped glass fiber strands. It is believed, without limiting the invention, that it is the moisture content and the uniformity of the moisture content that enables the wet chopped glass fiber strands to have good flowability properties.

The amount of the aqueous sizing on the wet chopped glass fiber strands varies from about 0.01 to about 0.5 percent LOI. The percent LOI will be higher when a starch film former is present. The wet chopped glass fiber strands can be chopped into any length and the diameters of the glass fibers can be any diameter from the microsized glass fibers to the coarser diameter glass fibers even including coarse glass fiber strands having a diameter of around 27 microns. On average, a better result is obtained with the aqueous sizing composition of the present invention on the coarser glass fiber strands ranging in diameter from about 3 to about 27 microns.

The wet chopped glass fiber strands can be used in bulk handling apparatus for mixture with various matrices. An example of such a matrix is gypsum. In addition, the wet chopped glass fiber strands can be used in producing non-woven glass fiber strand mat. There is no absolute fiber length for a given glass fiber diameter in the production of non-woven glass fiber strand mat but generally the half-inch chopped strands having a diameter of around 16 microns can be used. As the lengths increase, the fiber diameters can also increase and mixtures of various lengths and various diameter glass fiber strands can be used. The wet chopped glass fiber strands in any suitable length and diameter can be used for producing non-woven glass fiber strand mat. This invention can be carried out by employing any glass fibers conventionally employed to form glass mats. Preferably, the glass fibers will have a diameter within the range of about 3 to 27 microns and will have a length of about ¼ inch to 3 inches.

The wet chopped glass fiber strands can be formed into a non-woven glass fiber strand mat by any suitable process known to those skilled in the art.

The wet chopped sized glass fibers of the present invention can be used in conjunction with conventional paper making apparatus such as the inclined wire, the rotoformer or the fourdrinier machines. The wet chopped glass fiber strands of the present invention can be used with or without dispersing aids to form a dispersion of glass fiber strands in an aqueous suspension for use in the wet-laid process or other paper making processes and machines.

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(51) INT CL² C07D 487/12; A01N 9/22; C08K 5/34//A61K 7/06
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(19)

(54) PRODUCTION OF FIBROUS SHEET MATERIAL

(71) We, KARL KROYER ST. ANNE'S LIMITED, a British Company of St. Anne's Road, Brislington, Bristol, BS4 4AD, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention concerns a process and apparatus for making fibrous material e.g. paper, paper board, folding box-board and carton board. Although not so restricted it will hereinafter be described with reference to the manufacture of carton board grades of folding boxboard, and paper.

Conventionally made fibrous sheet materials when machine made suffer from the disadvantage that their dimensional stability is poor particularly in the cross machine direction, they are prone to curling and have physical characteristics e.g. stiffness and tensile strength which are markedly different in the cross-machine direction compared with the machine direction.

It has been found possible to avoid such undesirable characteristics by forming dry-laid fibrous webs. However a problem arises in the production of dry laid webs particularly in making paper and paperboard e.g. for cartons in that the development of strength is difficult to achieve without the use of excessive additives in the form of synthetic resins and binders or starch. Such additives are costly and, if added in excess can cause the product to be brittle, thus affecting the flexibility and folding qualities of the sheet. Similar detrimental affects can result by endeavouring to subject the web to excess heat. Excessive moisture, added to increase bonding properties is not attractive since the essence of the dry laid technique is of course to minimise the use of water. The use of excessive heat and/or pressure in hot pressing the web can cause serious adverse effects on the final sheet, particularly the surface characteristics resulting in difficulties in printing cutting and creasing the sheets.

It is possible to press a heated moistened web of dry laid fibres to consolidate the web into a sheet, but strength cannot be developed simply be repeating the simple pressing operation, as tests detailed below will demonstrate.

According to the present invention there is provided apparatus for forming a sheet of paper or paperboard comprising a permeable band, means for dry-laying a travelling web of fibres on the band, means for ensuring the web is moist, and consolidating means for receiving the newly-laid moist web comprising a consolidating surface, means for heating the surface, backing means for maintaining travelling the web in continuous contact with the surface, and pressure nips acting against the backing means at upstream and downstream locations so as to increase locally the pressure on the web against the surface whilst it is maintained in continuous contact with the surface by the backing means.

The backing means may be provided by the permeable band.

The pressure nips are preferably provided by at least two pressure rollers in co-operation with the consolidating surface, which is preferably provided by the surface of a smooth cylinder.

There may be provided a further pressure nip defined in part by a plain roll, and means for feeding the consolidated web through the further pressure nip. The plain roll may be heated.

When the apparatus is in operation the moisture content of the newly-laid moist web is preferably less than 50% by weight, e.g. 30%, the pressure of the consolidating nips is preferably at least 150 p.l.i., e.g. 200—250 p.s.i., and the consolidating

surface is preferably at a temperature of at least 150°F, preferably 200—350°F e.g. 220°F.

Starch may be added to the fibres or the fibrous web. At least 1% by weight and preferably 10% is added.

The invention is illustrated, merely by way of example, in the accompanying drawings in which:—

Figures 1—5 are diagrammatic illustrations of five different forms of apparatus for developing strength characteristics in dry laid fibrous webs,

Figure 6 is a graph of the results obtained from experiments carried out with the apparatus of Figures 1—5.

Figures 7, 8 and 9 are diagrammatic views of three alternative forms of machines for forming sheets of dry-laid fibrous materials according to the present invention.

In carrying out experiments to determine the best method of developing strength in a dry-laid fibrous webs, webs were formed from a mixture of mechanical refiner ground wood pulp and 5% by weight Viscosol 220 (Registered Trade Mark) starch. This mixture was dry-laid onto a permeable band and sprayed with water to a 30% moisture content. With the band, the moistened web was passed through a number of different consolidating arrangements of heated pressure nips to determine the most effective. In each case a pressure nip was provided by running a rubber pressure roll (7, 20) against a smooth furface heated metal roll (6, 18) which had been steam-heated to a surface temperature of 220° F. A constant pressure of 200 p.l.i. (pounds per linear inch) was applied to each pressure nip.

For each experiment, an endeavour was made to form a web of 200 gsm dry basis weight. This was not always possible with the restraints of the experimental apparatus and a correction factor was employed to correct the results for an effective basis weight of 200gsm.

The measure of strength used for this series of experiments was 'burst' measured in p.s.i. (pounds per square inch) by method T807 of the Technical Association of the Pulp and Paper Industry ("Tappi").

Figures 1—5 illustrate the configurations of pressure nips used in the experiments. Each figure illustrates only one of a series of experiments using that basic configuration. In each case the experiment was repeated using a number of pressure nips.

Referring to Figure 1, this series of experiments involved a heated roll (6) cooperating with a pressure roll (7) to provide each pressure nip. The dry-laid web 10, produced in the manner described above, was passed through each nip with the web unsupported i.e. no support band or belt was used. Three experiments were carried out, using one, three and four pressure nips in series. Only one experiment, using three pressure nips, is illustrated.

Referring to Figure 2 the series of experiments was repeated using one two three and four nips, in this case the web 11 was supported on a permeable wire belt or band 12.

In the series of experiments illustrated in Figure 3 the web 13 was supported between two permeable wire belts 14 and 15. The experiment was repeated with one two three and four pressure nips.

In Figure 4 the series of experiments involved a large common heated roller or cylinder against which the pressure rollers were placed. The wire belt 16 acting as a backing effectively wrapped the heated roller (18) between the pressure rollers (20) whereby the web was maintained in contact with the hot surface of the heated roller. The experiment was repeated with one two and four nips.

A further series of experiments was carried out using the configuration of Figure 5. This was basically the same as Figure 4 with the addition of a plain rubber pressing roll 21 which provided a pressure nip through which the unsupported web 19 passed after it had been pressed and initially consolidated by the previous pressure nips and whilst supported by wire belt 16. Thus the wire belt 16 did not pass completely around the heated roller (18) but only around part of the roller. In the example illustrated the wire was removed and returned to the forming section after the second pressing roll (20), the web continuing on the surface of the heated roll until it passed the pressing roll 21 after which it was removed from the apparatus.

The plain pressing roll 21 was applied at a pressure of 300 p.l.i. in this series of experiments, the previous pressure rolls (20) being applied at the standard 200 p.l.i. used throughout the experiments.

This series of experiments was effected using only two arrangements, the one illustrated and another in which only one pressure roll (20) was used, followed by a plain roll 21.

The webs produced in each series of experiments were subjected to the Tappi method to determine burst strength and the results obtained are shown in Table 1 and illustrated in Figure 6.

TABLE 1

Configuration	No. of nips	Basis Weight (gsm)	Caliper μm	Burst psi	Burst Corrected for BW 200 gsm
Fig. 1	1	196	550	11.7	12.0
	3	183	370	10.5	11.5
	4	177	322	9.3	10.5
Fig. 2	1	202	560	10.2	10.1
	2	200	545	10.0	10.0
	3	185	560	4.5	4.9
	4	176	550	1.2	1.4
Fig. 3	1	220	520	1.2	1.1
	2	180	550	1.5	1.7
	3	188	520	2.4	2.6
	4	190	520	4.0	4.2
Fig. 4	1	200	545	10.4	10.4
	2	202	550	10.8	10.7
	4	188	385	12.0	12.8
Fig. 5	1+1	219	475	14.0	12.8
	2+1	206	495	14.4	14.0

Considering the results, it will be seen that no great strength was developed in the Figure 3 configuration. It is felt that this was primarily due to the heat loss created by the presence of the two wires, thereby preventing sufficient heat reaching the fibrous web. Configuration of Figures 1 and 2 started reasonably well with a single nip, but in both cases the strength could not be developed by increasing the number of nips. Indeed strength fell in both cases. In the Figure 2 embodiment the poor results are thought to result from heat losses between pressings and the sequence of pressing and relaxing the pressure causing weakening of the fibre bonds. In the case of Figure 1 arrangement, the problem is one of more practical nature rather than the lack of strength. The pulp was found to stick to the rollers and of course was extremely difficult to handle before and between pressure nips. The configuration is not practical. Also the web lost strength for the reasons explained with reference to Figure 2.

The results obtained from Figures 4 and 5 apparatus were most encouraging. Both indicated that strength could be developed by this technique. It is thought that this is due to the continued intimate contact of web with heated surface preventing cooling and maintaining some pressure even between nips. Thus the pressing accompanied by heat is continuous and results in a development of strength.

The experiments described above have been effected using standard moisture and binder content, pressures, temperatures and speed. It is known that even the strengths obtained can be further improved by altering these variables.

A further series of experiments was conducted using the configuration of Figure 5. In view of the encouraging results obtained with a plain unheated roll (21) in developing strength in the previously consolidated sheet, it was arranged to replace the roll 21 with a heated plain roll. A consolidated web laid from New Bern Hardwood bleached kraft was used with 5% viscosol 220. A target weight of 200 gsm was used and the results of the actual webs (170—180 gsm) were corrected to this target. The cylinder 18 was run at a temperature of 284° F and the plain heated roll (21) was run at various temperatures and at varying pressures. The stiffness and the burst factor (corrected) were determined for each web produced. The series of runs and results are listed in Table 2.

TABLE 2

Run No.	Temperature of plain roll	Nip pressure	Stiffness	Burst Factor
	°F	p.l.i.	Kenley Units	
1	0	0	1.7	8.6
2	320	100	3.0	9.0
3	320	200	6.8	10.5
4	320	230	6.8	10.8
5	320	300	—	11.2
6	400	200	7.4	11.4
7	400	300	8.0	11.8
8	400	400	9.0	12.5

Referring to Table 2 it will be seen that compared with no plain roller at all (run 1) the stiffness and strength (burst factor) increased with both temperature and pressure. Burst increased between runs 1 and 8 by 50% and stiffness by a factor of more than 5.

An additional advantage of the plain roll, particularly when heated, is the pressing effect on the surface of the web, which reduces the wire mark and improves the surface characteristics.

Rather than use a plain heated roll in contact with heated cylinder 18, a heated nip could be provided by two other pressure rolls i.e. not co-operating with roll 18. A callendar stack may be used for example. On the other hand a number of heated rollers may be spaced about cylinder 18 or about another such cylinder to which the previously consolidated web is fed.

With the need to develop very high strengths, it may be necessary to modify the moisture content of the consolidated web. This can be done by spraying or preferably with a wet felt between consolidating and the further hot pressing with plain rolls.

Practical application of the results of this work is illustrated in Figures 7, 8 and 9 which show three configurations of paper and paper board machine employing the embodiments of Figures 4 or 5.

Figure 7 of the drawing which shows a machine for making sheets from dry laid fibres. The machine comprises an endless belt or band 9 (of plastic or felt) on which are laid dry fibres mixed with a dry binder such as powdered starch. Different mixtures are deposited in an air stream from distributor heads 10, 11, 12 and 13. For example, from heads 11 and 12 is deposited a 150 gsm layer of refiner groundwood pulp mixed with 10% by weight dry Viscosol (Registered Trade Mark), a powdered starch. From heads 10 and 13 are deposited webs of 20gsm and 40gsm respectively of a chemical white pulp fibre such as Stora fluffing pulp from Stora Kopperberg mixed with 4% by weight dry Viscosol.

Vacuum boxes 14 hold the mixtures on the belt 9.

The resulting dry-laid multi-ply web is passed through compacting rollers 14 at 10 p.l.i. nip pressure and under wetting sprays 15, 16 where it is sprayed with water to provide a moisture content of 30% by weight. The moist web backed by belt 9 passes around the surface of a steam heated cylinder 17 being pressed into contact therewith over one quarter of its periphery by press rolls 18. The cylinder is 12 feet in diameter, surface temperature 230° F. Each nip pressure 250 p.l.i. At the lowest point on the cylinder the sheet is compacted and the moisture content has been reduced to within the range 15 to 20% by weight. The web or base sheet so formed is contacted by a transfer fabric 20 which continues the pressing action, with cold (unheated) rolls the base sheet leaving the cylinder with a moisture content of approximately 15% by weight. The sheet is transferred to a dryer fabric 22 which passes the web through a stack of drying cylinders 23 to reduce the

moisture content to approximately 10% by weight. The dried, formed base sheet passes on to vertical size press 24 and further drying cylinders 25 and other treatment units at 26 before passing as finished board to the finishing and reel-up units (27).

Referring now to Figure 8 there is shown an alternative form of machine which differs from that of Figure 7 in a few small details. The main difference is that two wire belts are used for laying, compacting and hot moist pressing the web. One wire belt, 109 carries the dry laid fibres mixed with Viscosol from heads 110 and 112 through compacting rollers 114. The web 106 is then passed onto a second wire belt 107 which carries it under spray heads 115, 116 and around heated cylinder 117 past press rolls 118. A heated plain roll 119 could be added.

With the apparatus of Figure 8, 110gsm is laid by each head, head 110 laying refiner ground wood with 4% Viscosol and head 112 laying chemical wood pulp with 4% Viscosol. The compacting rollers 114 apply a nip pressure of 10 p.l.i.

The parameters of the machine are the same as those of the Figure 7 embodiment. However no transfer fabric is employed on the cylinder 117. The web passes directly to the stations 123—127 which correspond to 23—27 of Figure 7.

Although as described above a cylinder 12 feet in diameter and having a surface temperature of 230° F was employed, experience does indicate that a smaller cylinder, say 6 feet diameter using a surface temperature of say 350° F could be preferable for certain applications. Also increasing the pressure of the rolls, modifying the moisture content and/or binder content can also vary the characteristics appreciably.

Thus Figure 9 shows an arrangement which could be used for producing paper webs. Fibres are deposited on to a porous screen 30 made of plastic, wire or porous felt. The web passes through press rolls 31 operating at 10 p.l.i. and is sprayed by a spray head 32. Two press rollers 33 press the web at 250 p.l.i. against a 6 feet diameter steam heated cylinder 34 having a surface temperature of 300° F. Further pressing takes place by plain rolls 35 heated to 400° F which press against the web directly at 400 p.l.i. and urge it into contact with cylinder 34 without an intervening wire. Finally, further treatment as may be required is carried out by application at a size press 36 and drying stack 37 before the sheet is reeled up at 38.

Physical properties of the base sheet (i.e. before finishing and coating) formed on the machines of Figures 7 and 8 (without roll 119) are compared with a conventionally made wet laid board in Table 3. Also included in Table 3 are the characteristics of the same dry laid sheet after finishing and coating.

Conventional British Standard methods were employed for measuring tensile (using a Schopper tensile tester), and stretch under stress and stiffness was measured using a Kenley tester.

TABLE 3

Property	A	B		C	
		(i)	(ii)	(i)	(ii)
Basis Weight (gsm)	259	240	290	210	250
Caliper (microns)	442	480	450	420	460
Bulk Ratio (asg)	0.59	0.50	0.64	0.50	0.54
Dimensional Stability (%)					
M/c Direction	0.05	0.05	0.05	0.05	0.05
Cross M/c Direction	0.50	0.05	0.05	0.05	0.05
Ratio Cross M/c to M/c	10:1	1:1	1:1	1:1	1:1
Tensile (kgm/1.5 cm Width) (Schopper Tensile Tester)					
M/c Direction	25.5	7.7	7.9	6.9	7.3
Cross M/c Direction	7.9	7.7	7.9	7.1	7.4
Ratio M/c to Cross M/c	3.2:1	1:1	1:1	1:1	1:1
Stretch (%) Under Stress					
M/c Direction	3.1	2.7	2.7	2.5	2.5
Cross M/c Direction	4.4	2.7	2.7	2.5	2.5
Ratio Cross M/c to M/c	1.4:1	1:1	1:1	1:1	1:1
Stiffness (Kenley Units)					
M/c Direction	35.0	7.6	15.8	5.8	14
Cross M/c Direction	10.7	7.4	15.6	5.7	14
Ratio M/c to Cross M/c	3.3:1	1:1	1:1	1:1	1:1

Code

A. Conventional wet laid white lined Duplex type board.

B. Dry laid white lined Duplex type board

(i) before finishing and coating

(ii) after finishing and coating.

C. Dry laid white lined Triplex type board

(i) before finishing and coating

(ii) after finishing and coating.

Further treatment is shown in Figures 7 and 8 such as application at the size press and at the coating head of suitable sizing and surfacing. With these further treatments, the base sheet characteristics can be altered. Thus strength characteristics such as stiffness can be greatly enhanced to bring it to the requirement of the converting process without adversely affecting the other properties or the squareness of the product.

It will be seen that the sheet so formed is virtually 'square' in that the ratio of its physical properties in the cross-machine direction and the machine direction is substantially 1:1. The same ratio is applicable to the physical characteristics of the base sheet taken in any two mutually perpendicular directions in the plane of the sheet thus providing an "homogeneous" sheet.

One of the most beneficial characteristics of the new product, is the dimensional stability of the sheet to changes in atmospheric humidity. It will be seen that the sheet is virtually completely stable, having a percentage change of only 0.05 in both machine and cross machine directions. Similar values are expected in all directions in the plane of the sheet.

Such a stable sheet has great benefits for the converter. The printer will have less problem with register and, particularly on multi-colour printing, this will greatly increase efficiency as well as drastically reducing scrap. The carton cutter creaser and maker will also benefit since the stable sheet will provide stable size cartons having stable dimensions and this will greatly increase the efficiency of the carton making as well as the packaging machinery. Rotary printing cutting and creasing are particular areas benefiting from the stable sheet.

The squareness and homogeneity of the resulting sheet also has benefits for the converter i.e. the printer and carton board manufacture. It is known that in conventional board better creasing can be effected in the cross machine direction compared with the machine direction. With the present sheet there will be less difference and indeed the difference can be eliminated. Thus the carton maker will not be limited on the manner in which he must set out or lay down carton blanks on a sheet. Whereas carton blanks have conventionally been laid down transversely of a web of material i.e. with their longitudinal axis across the sheet, one can lay them down along the sheet with the present material. This gives the carton maker more flexibility particularly in accommodating more carton blanks across the web width. Large savings can result.

Furthermore by tending to equalise the properties of dimensional stability and shrinkage in the two directions, the problems of register and printing generally on rotary gravure machines will be decreased. Again, rotary cutting and creasing can be facilitated since more controllable sheets will be provided.

The present board has as good cutting and creasing properties in all directions as conventional board has in the cross machine direction. Furthermore it is found that the board is relatively easily mouldable. The board can be forced past its elastic limit more readily than in conventional boards. This facility not only avoids spring-back of normal folded creases but also enables one to mould the board to many different shapes. The creases will also be sharper and will provide the resulting carton with a squarer and more attractive appearance.

The bulk factor of the present product can be made far better than conventional board. This can provide greatly enhanced printing qualities particularly for gravure printing. Thus the bulkier board will be more compressible and will thus more readily withdraw the ink from printing rollers. Bulk will also provide greater protection for goods packed in cartons made from the board or, for the same caliper board, a lighter board can be used compared with conventional standards. Bulkiness also facilitates creasing and folding since the board is more compressible. Thus whereas conventional boards resists folding due to their low compressibility at the internal surface on corner creasing, present boards will readily compress and thus fold more readily. As well as giving sharper creases this provides less spring-back and more efficient folds.

Thus with the present invention there is provided a process and apparatus for consolidating and developing strength in dry-laid webs of fibrous material without the need for excessive moisture binder heat or pressure and in a practical and efficient manner which does not detract from the benefits of the dry-laying technique for web production. The process and apparatus is particularly well suited to the production of paper paperboards and folding boxboards.

The sheets characterised in table 3 are claimed in our copending application No. 1055/75 (Serial No. 1418030).

WHAT WE CLAIM IS:—

1. Apparatus for forming a sheet of paper or paperboard comprising a permeable band, means for dry-laying a travelling web of fibres on the band, means for ensuring the web is moist, and consolidating means for receiving the newly-laid moist web comprising a consolidating surface, means for heating the surface, backing means for maintaining the travelling web in continuous contact with the surface, and pressure nips acting against the backing means at up-

stream and downstream locations so as to increase locally the pressure on the web against the surface whilst it is maintained in continuous contact with the surface by the backing means.

2. Apparatus as claimed in claim 1 wherein the backing means is provided by the permeable band.

3. Apparatus as claimed in claim 1 or 2 wherein the pressure nips are provided by at least two pressure rollers in co-operation with the consolidating surface.

4. Apparatus as claimed in any preceding claim wherein the consolidating surface is provided by the surface of a smooth cylinder.

5. Apparatus as claimed in any preceding claim including a further pressure nip defined in part by a plain roll, and means for feeding the consolidated web through the further pressure nip.

6. Apparatus as claimed in claim 5 wherein the plain roll is arranged to contact that surface of the consolidated web previously in contact with the backing means.

7. Apparatus as claimed in claim 5 or 6 wherein the further pressure nip is defined by two plain rolls.

8. Apparatus as claimed in claim 5 or 6 wherein the further pressure nip is defined by the plain roll in co-operation with the consolidating surface.

9. Apparatus as claimed in claim 6, 7 or 8 wherein the further pressure nip includes one heated plain roll, and means for feeding the unsupported consolidated web thereto.

10. Apparatus as claimed in any one of claims 5 to 8 including means to heat the or each plain roll.

11. Apparatus as claimed in claim 10 wherein, in operation, the plain roll is maintained at a temperature of 300—500° F, and the further pressure nip is maintained at a pressure of 150—500 p.l.i.

12. Apparatus as claimed in any preceding claim wherein, in operation, the moisture content of the newly-laid moist web is less than 50% by weight, the pressure of the consolidating nips is at least 150 p.l.i., and the consolidating surface is at a temperature of at least 150° F.

13. Apparatus as claimed in claim 12 wherein, in operation, the moisture content of the newly-laid moist web is 30% by weight, the pressure of the consolidating nips is 200—250 p.l.i., and the consolidating surface is at a temperature of 200—350° F.

14. Apparatus as claimed in claim 13 wherein, in operation, the moisture content of the newly-laid moist web is 30% by weight, the pressure of the consolidating nips is 200 p.l.i., and the consolidating surface is at a temperature of 220° F.

15. Apparatus as claimed in claim 3 wherein the pressure rollers are unheated and cold.

16. Apparatus as claimed in any preceding claim wherein the means for ensuring the web is moist is provided by a water spray directed onto the dry-laid web.

17. Apparatus as claimed in any preceding claim including means for adding at least 1% by weight of starch to the fibres or the fibrous web.

18. Apparatus as claimed in claim 17 wherein 10% by weight of starch is added to the fibres or the fibrous web.

19. Apparatus for forming a sheet of paper or paperboard substantially as hereinbefore described with reference to and as shown in any one of Figures 4, 5, 7, 8 and 9 of the accompanying drawings.

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Agent for the Applicants.

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1424682 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

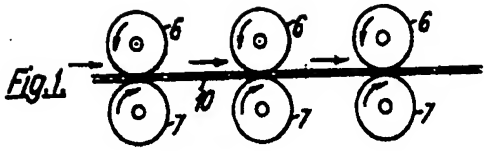

Fig.1.

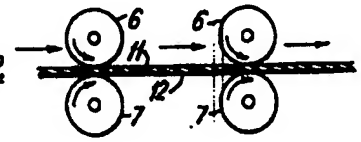

Fig.2.

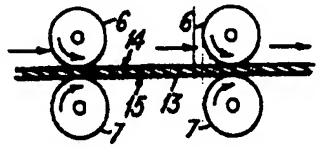

Fig.3.

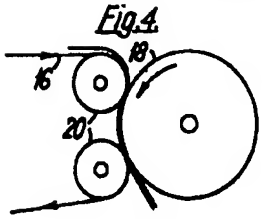

Fig.4.

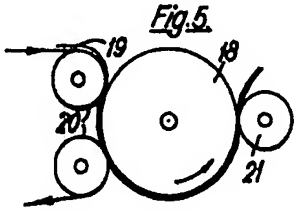

Fig.5.

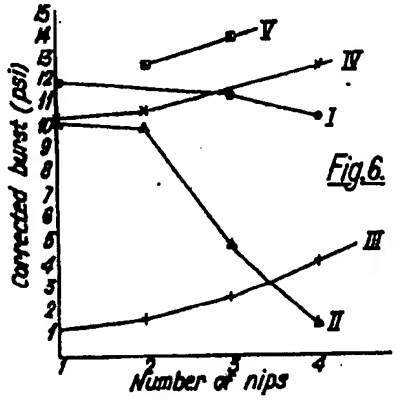

Fig.6.

1424682 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

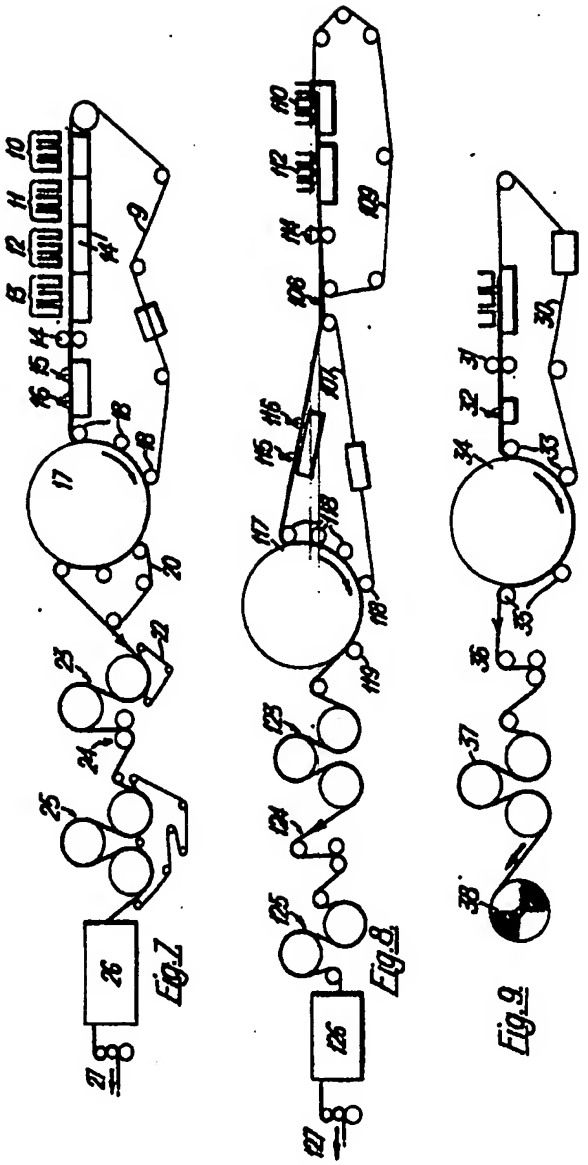

Fig.7

Fig.8

Fig.9

United States Patent [19]

Temple

[11] **4,240,944**

[45] **Dec. 23, 1980**

[54] **EMULSION COMPOSITION AND METHOD FOR USE IN TREATING GLASS FIBERS**

[75] Inventor: **Chester S. Temple, McKees Rocks, Pa.**

[73] Assignee: **PPG Industries, Inc., Pittsburgh, Pa.**

[21] Appl. No.: **11,454**

[22] Filed: **Feb. 12, 1979**

[51] Int. Cl.³ **C08L 23/12**

[52] U.S. Cl. ..... **260/29.6 NR**; 428/391; 428/392

[58] Field of Search ..... 260/29.6 XA, 29.6 NR, 260/29.6 WB; 428/391, 392

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Primary Examiner—Paul R. Michl

Attorney, Agent, or Firm—Kenneth J. Stachel

[57] **ABSTRACT**

A binder composition and method for using same in sizing compositions for treating glass fibers is provided. The binder composition is an aqueous emulsion containing isotactic carboxylated polypropylene along with amorphous carboxylated polypropylene, base, and surfactant. The isotactic carboxylated polypropylene is incorporated in the emulsion by a method of co-emulsification of the isotactic and amorphous carboxylated polypropylene in a ratio of 1:1 to 1:4 parts by weight along with the base and surfactant. Water is added to the co-emulsified blend to obtain the emulsion with the desired solids content.

7 Claims, No Drawings

EMULSION COMPOSITION AND METHOD FOR USE IN TREATING GLASS FIBERS

BACKGROUND OF THE INVENTION

The present invention relates to a composition and method of making same for use in a size composition for treating glass fibers during or after forming with an aqueous size composition which prepares the glass fibers for bonding to polyolefin resin in the reinforcement of specific polyolefin materials.

Glass fibers have many uses one of which is for reinforcement material in the form of continuous strands, chopped strands, mats, roving or woven cloth for polyolefins. The glass fiber reinforced polyolefins have better dimensional stability, tensile strength, flexural modulus, flexural strength, impact resistance and creep resistance than unreinforced polyolefin material.

The glass fibers for use as reinforcement material are made by drawing at a high rate of speed a multitude of molten glass streams that flow from small openings in a bushing. The fibers are treated with a size composition that performs several functions. It protects the fibers during gathering into a strand or strands and during further processing. It also has the capability to couple or to adhere the glass fibers with the polyolefin material in which the glass fibers are to be used as reinforcement. In addition, the size composition makes the surface of the glass fibers compatible with the polyolefin material. The size composition performs these functions by containing the following components usually in an aqueous dispersion or an emulsion: a glass fiber lubricant, a coupling agent, and a film forming synthetic resinous binder. After the glass fibers are treated with the size composition, they are gathered together and wrapped on a tube or spool by a winder that usually also provides the pulling force to draw the fibers to produce a forming package. The glass fibers are removed from the forming package to produce the fiber glass products used to reinforce polyolefin material.

The glass fiber strand to be treated with the size composition containing the binder composition of the present invention may be typically produced according to the teachings of U.S. Pat. No. 2,133,238. The glass fiber strands are composed of a multitude of fine glass filaments which are formed by being drawn at a high rate of speed from molten cones of glass located at the tips of small orifices in a bushing. During the formation of the glass fibers, the filaments are coated with the size composition containing the binder composition of the present invention. Coating of the filaments takes place while they are moving at a speed in the order of 1,000 to 20,000 feet per minute. The coating is accomplished in the immediate vicinity of the hot bushings and the glass furnace in which the glass is melted. After coating, the glass fibers move a short distance onto a collecting means, whereupon they are subsequently dried to drive off residual moisture.

It is to be understood that the sized glass fibers may be formed and the size composition applied by the known methods of fiber formation and sizing application. Representative of a method of fiber formation and sizing application is the process illustrated in FIG. 2 of U.S. Pat. No. 3,849,148 which is hereby incorporated by reference. Glass fiber filament emerge from orifices of an electrically heated bushing. These fibers are attenuated and by means of a strand pulling device these filaments are gathered to form a strand of glass fiber which may comprise numerous individual fibers. The sizing is applied to the fibers by conventional size applicators such as a kiss-roll applicator or a belt applicator device. Details of a sizing applicator is shown in U.S. Pat. No. 2,728,972. The filaments after exiting the bushing are cooled by air or preferably water. The filaments are gathered into bundles by a gathering shoe and are then lead to a strand pulling device such as that illustrated in U.S. Pat. No. 3,292,013, as well as, in the above-referenced, patent U.S. Pat. No. 3,849,148. The glass fiber strand or strands, if the filaments exiting from the bushing have been separated into several strands, are then wound onto a forming tube on a collet rotating at approximately 7,500 rpm to produce a strand travel of approximately 12,000 to 15,000 feet per minute. The glass fiber strand forming packages are then dried. This generally is accomplished by baking the packages of glass fibers at a temperature and for a period of time sufficient to remove substantially all the water. Generally a curing time for the instant size composition is about 11 hours at 270° F. (132° C.).

The glass fiber strand sized with the size composition having the binder composition of the present invention can be further processed in several ways to be used as reinforcement for polyolefin materials.

One approach involves forming the glass fibers and treating the glass fibers with the size composition in the aforementioned methods. The filaments are gathered together to form one or more strands. The strand or strands are passed through a free wheeling feed roll which aligns the strands for the subsequent cutting action. The feed roll is in contact with a cot roll that together provide the attenuation necessary to form the fibers. The strand or strands are then passed between the cot roll and cutting blades. The chopped strand then falls onto a conveyor as a wet chopped strand. The wet chopped strand is conveyed to a heater to reduce the moisture of the strand to produce dried chopped strand for use as reinforcement.

chopped in ¼" lengths and direct dry in blend molded Pro-Fax 6323PM (12 melt flow) and Pro-Fax 6523PM (4 melt flow) polypropylene resins at temperatures of 450°, 500° and 500° F. (232° C.) (260° C.) (288° C.). All these resins are available from Hercules, Inc.

EXAMPLE 3

A size composition made in a manner similar to that of Example 1 except it had 15 percent of the emulsion identical to that of Example 1 and a concomitant increase in the amount of polyurethane film former.

The size composition of Example 2 was used to treat glass fibers made in the aforedescribed process for producing chopped glass fiber strands. The strands were

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(22) Date of filing: 03.01.85

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(84) Designated Contracting States: AT BE CH DE FR GB IT LI LU NL SE

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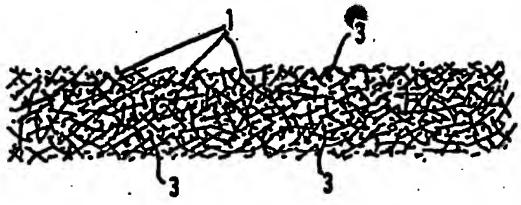
(54) Improvements in fibre reinforced plastics structures.

(57) An air permeable sheet-like structure comprising 20 to 60% by weight of reinforcing fibres having a high modulus of elasticity (as herein defined), and being between about 7 and about 50 millimetres long, and 40 to 80% by weight of wholly or substantially unconsolidated particulate plastics material, and in which the fibrous and plastics components are bonded into an air permeable structure.



EP 0 148 760 A2

IMPROVEMENTS IN FIBRE REINFORCED PLASTICS STRUCTURES

This invention relates to sheet-like fibrous structures, and in particular to such structures for use in the production of fibre reinforced plastics materials or articles. The invention also relates to a process for making such materials.

Plastics sheet materials made from thermoplastic resins are widely used in the manufacture of moulded articles. Such materials are, however, not of great strength or rigidity, and where such properties are required, fibre reinforcement is introduced.

Thus, for example, in the manufacture of one such material, layers of glass fibre mat are interposed between layers of thermoplastics material, the composite structure being needled to produce a degree of integration of the layers and then heated under pressure to produce consolidated rigid sheets for use in moulding.

However, for satisfactory moulding of such sheets, they must be homogeneously preheated. This requires both time and accurate temperature control if overheating and degradation of the sheet surfaces is not to occur whilst the core portions of the sheets are brought up to the required moulding temperature. Also, for a moulding of given dimensions, an optimum size of consolidated sheet is required if excessive waste in the form of flash is to be

avoided. As a result a moulder who manufactures a wide range of mouldings must carry a corresponding range of sheet sizes, be prepared to cut large sheets to an appropriate size or accept a high degree of wastage.

Furthermore, when used for deep draw moulding it is found that such materials are not capable of being used to form mouldings of uniform structural strength. This is because the glass fibre mat is constituted of very long glass fibre strands (i.e. fibre bundles) of perhaps 200 centimetres or more which extend in a random serpentine manner throughout the whole sheet. This substantially restricts their movement during moulding in that they cannot flow with the thermoplastics material constituting the remainder of the structure. As a result, relatively thin parts of the moulding such as stiffening ribs are starved of fibre reinforcement. Additionally, because of the mode of manufacture of such reinforced sheets, they have to be fully consolidated by the application of heat and pressure in order to be transportable. As a result, they can only be supplied to the moulder as flat, impermeable and rigid sheets which are difficult to handle in a continuous moulding process.

It is among the objects of the present invention to provide a composite fibre and plastics material for use in the moulding of fibre reinforced plastics articles which overcomes or alleviates the disadvantages of known materials as described above.

The invention therefore provides an open sheet-like structure comprising

- from 20% to 60% by weight of reinforcing fibres having a high modulus of elasticity (as herein defined), and

between about 7 and about 50 millimetres long, and
- from 40% to 80% by weight of wholly or substantially unconsolidated particulate plastics material
- the fibrous and plastics components being bonded into an air permeable structure.

Preferably, the fibres are in the form of single discrete fibres. Thus, where glass fibres are used, and are received in the form of chopped strand bundles, the bundles are broken down into single fibres before the structure is formed.

A high modulus of elasticity is to be taken as meaning a modulus of elasticity substantially higher than that of a consolidated sheet which could be formed from the structure. Fibres falling into this category include glass, carbon and ceramic fibres and fibres such as the aramid fibres sold under the trade names Kevlar and Nomex and will generally include any fibre having a modulus higher than 10,000 Mega Pascals.

Particulate plastics material is to be taken as including short plastics fibres which may be included to enhance the cohesion of the structure during manufacture.

Bonding may be effected by utilizing the thermal characteristics of the plastics material within the structure. Thus the structure may be heated sufficiently to cause a thermoplastic component to fuse at its surfaces to adjacent particles and fibres. Or a post formable thermosetting component may be so heated to produce a similar effect. Care must be taken however to ensure that the conditions of heating are such as to prevent degradation of the plastics material after bonding.

Alternatively, a binder may be added during manufacture of the structure to effect bonding. Any binder may be used which will effect a bond at a lower temperature than that which would result in consolidation of the plastics material within the structure. Suitable binders include polyvinyl alcohol, polyvinyl acetate, carboxymethyl cellulose and starch.

Individual fibres should not be shorter than about 7 millimetres, since shorter fibres do not provide adequate reinforcement in the ultimate moulded article. Nor should they be longer than 50 millimetres since such fibres are difficult to handle in the preferred manufacturing process for the fibrous structure.

Preferably glass fibres are 13 microns in diameter or less. Fibre of diameters greater than 13 microns will not so efficiently reinforce the plastics matrix after moulding.

Preferably, the degree of bonding is controlled to cohere the components whilst still retaining sufficient flexibility to permit the structure to be reeled. In the reeled condition, it can be transported readily for use by a moulder in a continuous preheating and moulding process. Alternatively, and to minimize material wastage, shaped elements may be cut, pressed or stamped from the structure and supplied to the moulder in a form permitting articles to be moulded with minimum flash to be disposed of. The residual material may be recycled through the forming process, and neither the moulder nor the manufacturer of the fibrous structure will be faced with the need to dispose of waste material.

Alternatively, the degree of bonding may be such as to produce a rigid, but still air permeable sheet where this will meet the moulder's requirements. This is effected by adjusting the amount of the degree of fusing of the thermoplastic, or the amount of binder added to achieve the desired effect, the adjustment depending on the kinds of thermoplastics or binders used.

In those cases where the moulder is only equipped to handle consolidated sheets, the fibrous structure may be consolidated by cutting into appropriate lengths and then heating and cooling under pressure. It will be appreciated that such consolidation can only be carried out when the plastics content of the sheet is wholly of thermoplastics material.

In another aspect, the invention provides a process for the manufacture of a permeable sheet-like fibrous structure, which includes forming a web with 20% to 60% of single fibres having a high modulus of elasticity (as herein defined) and between 7 and 50 millimetres long, and 40% to 60% by weight of a wholly or substantially unconsolidated particulate plastics material, and then treating the web to bond the fibres and plastics material together.

The web of fibres and plastics powder may also be formed using a dry laying technique as described in UK Patent No. 1424682. In this case, the binder may be applied by means of a spray or by dipping and draining the web after it has been formed.

In all cases however, after the web has been formed it is treated, usually by heating, to effect bonding without substantially consolidating the plastics particles held in the web. Slight metering may be effected to ensure that the structure produced has a constant thickness. However, pressure and temperature conditions must be less than those which would compact the web and consolidate any thermoplastic component or cure any thermosetting component which it may contain.

Optionally, where a customer is only equipped to handle consolidated sheets, and the plastics content of the fibrous structure is wholly of thermoplastics material, the structure is cut into required lengths, after which it is subjected to heating and cooling under pressure to effect consolidation.

Referring first to Figures 1 and 2, this shows an uncompacted fibrous structure comprising fibres 1 bonded together at their points of intersection 2 by a binder so as to form a skeletal structure within the interstices of which a particulate plastics material 3 is also retained by the binder.

Typically, the fibres are glass fibres 12 millimetres long and 11 microns in diameter, the binder is polyvinyl alcohol and the plastics material is polypropylene particles.

Means for optionally consolidating the material produced as described above are shown in Figure 4. This shows a continuous hot press of the steel band type (Sandvik Conveyors Ltd.) which may be employed to consolidate material received directly from the rolls 24 or material which has already been reeled. The press is shown at 30 in Figure 4 wherein a pair of travelling endless steel bands 31 are each retained around a pair of rotating drums 32 and 33. The separation between the pair of bands 31 decreases from the inlet 34 to the outlet 35 and defines a passage, through which the web (not shown) is conveyed from right to left. Between drums 32 and 33 there are provided six sets of roller chains 36a, 36b and 36c arranged in pairs on opposite sides of the passage adjacent the bands 31. The lower sets of chains 36a, 36b and 36c are fixed but the upper sets are reciprocally mounted and connected to hydraulic rams 37. In this way, each pair of chains 36a, 36b and 36c serves to guide and maintain the bands 31 in position and also to consolidate the web whilst being conveyed through the passage. Between chains 36b and 36c, there are provided two nip rolls 38 which are disposed on opposite sides of the passage adjacent the bands 31; the lower roll being supported by a hydraulic jack 39. These rolls 38 further assist in the consolidation of the web. Within the sets of chains 36a and 36b are heating platens 40a and 40b which heat the bands 31 and in turn the web whilst cooling platens 40c are disposed within the set of chains 36c.

CLAIMS

1. An air permeable sheet-like structure comprising 20% to 60% by weight of reinforcing fibres having a high modulus of elasticity (as herein defined), and being between about 7 and about 50 millimetres long, and 40% to 80% by weight of wholly or substantially unconsolidated particulate plastics material, and in which the fibrous and plastics components are bonded into an air permeable structure.

2. An air permeable sheet like structure as claimed in claim 1 in which the fibres are in the form of single discrete fibres.

18. A process for the manufacture of a permeable sheet like fibrous structure which includes forming a web with 20% to 60% of single fibres having a high modulus of elsasticity (as herein defined) and between 7 and 50 millimetres long, and 40% to 60% by weight of a wholly or substantially unconsolidated particulate plastics material, and then treating the web to bond the fibres and plastics material together.

19. A process as claimed in claim 18 in which the fibres are in the form of single discrete fibres.

20. A process as claimed in claim 18 or claim 19 in which the particulate plastics material includes short plastics material fibres.

21. A process as claimed in claims 18, 19 or 20 in which the particulate plastics material components are bonded together to provide the bonding.

32. A process as claimed in any one of preceding claims 18 to 31 which includes forming the web on a paper making machine.

33. A process as claimed in any one of preceding claims 18 to 31 in which the web is made using the dry laying technique and the binder is applied by means of a spray or by dipping and draining the web after it has been formed.

34. A process as claimed in any one of preceding claims 18 to 33 in which the plastics content of the fibrous structure is wholly of thermoplastics material which is subjected to heating and cooling under pressure to effect consolidation.

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FIG. 2.

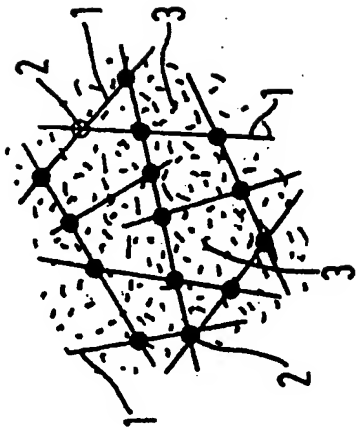
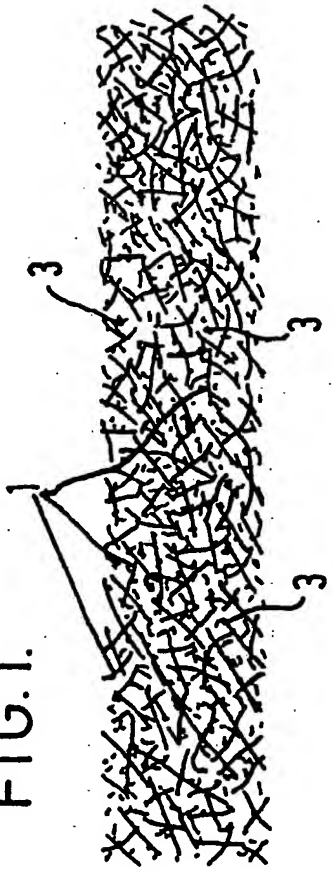


FIG. 1.



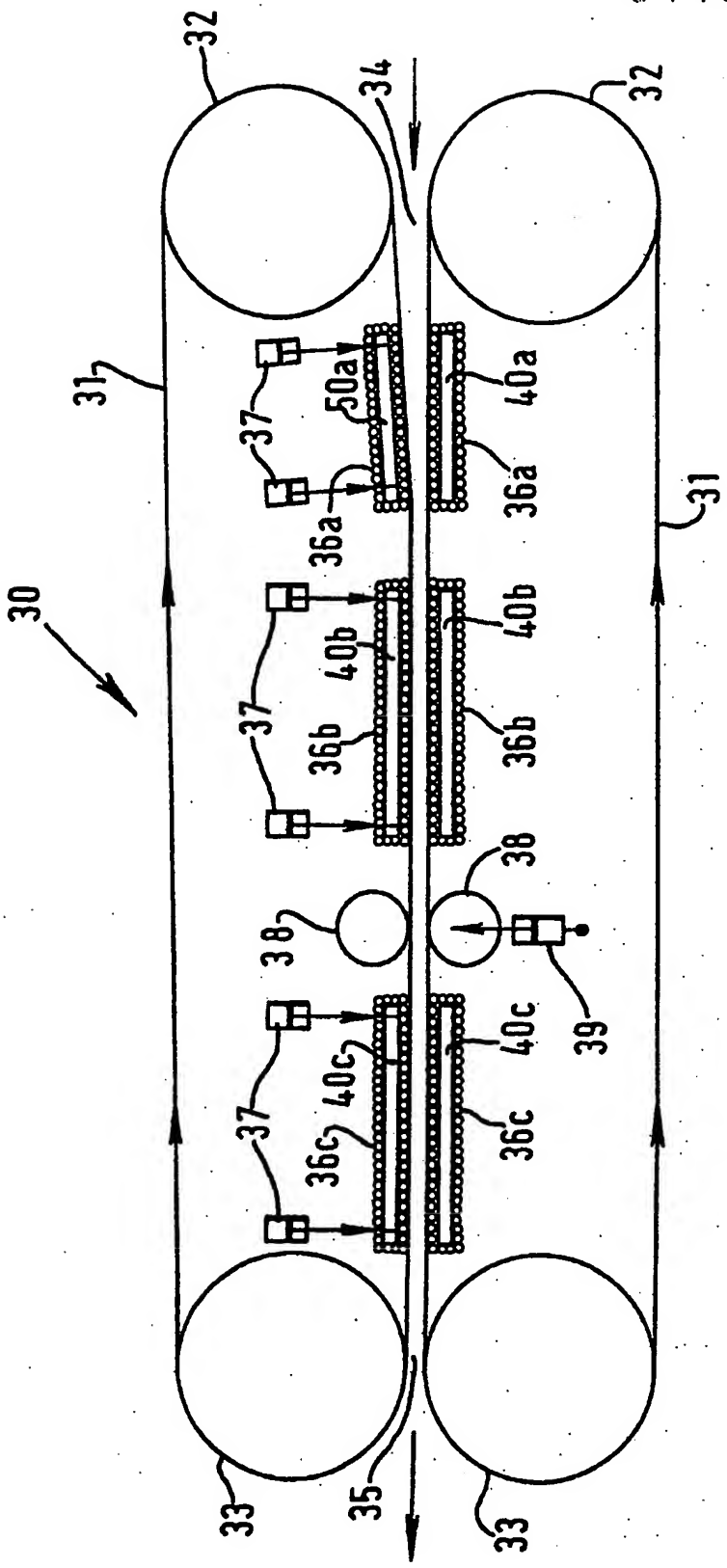


FIG. 4.

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	PUB. APP. NO.	Title
1	20050107182	HYBRID GOLF CLUB SHAFT
2	20050100853	Formable sheets for medical applications and methods of manufacture thereof
3	20050100697	Injection blow-molded disposable tumbler and method of making same
4	20050095433	Multilayered articles and method of manufacture thereof
5	20050095415	Glass mat thermoplastic composite
6	20050089707	Shaped contoured crushable structural members and methods for making the same
7	20050086823	Macrocellular acoustic foam containing particulate additive
8	20050084696	Multi-layer composites
9	20050084664	Element with very high mechanical resistance and high vibration absorption and method for implementing the same
10	20050082881	Twin-sheet thermoformed products
11	20050077075	Flexible stator bars
12	20050070673	Thermoformable propylene polymer compositions
13	20050070643	Coating compositions, their preparation, and coated articles made therefrom
14	20050064141	Structural component and method and a mold tool for its production
15	20050060943	Polishing pad with recessed window
16	20050059768	Polymerized macrocyclic oligomer nanocomposite compositions
17	20050048218	Process for coating substrates with polymeric compositions
18	20050040690	Seating system and method of forming same
19	20050038191	Poly(arylene ether)/polyamide composition
20	20050038171	Reinforced poly(arylene ether)/polyamide composition

21	20050038160	Ethylene copolymers with hollow fillers
22	20050038158	Highly filled ethylene/vinyl ester copolymers
23	20050037168	Thermoformed food trays having improved toughness
24	20050032950	Polyacetal and polyvinylbutyral compositions and blends having enhanced surface properties and articles made therefrom
25	20050030707	Protective enclosure for an interactive flat-panel controlled device
26	20050029494	Liquid crystalline polymer composition
27	20050028403	Footwear sole structure incorporating a cushioning component
28	20050027098	Sulfonated aliphatic-aromatic copolyesters and shaped articles produced therefrom
29	20050022631	Non-marring tool
30	20050020762	Scuff resistant compositions comprising ethylene acid copolymers and polyamides
31	20050019597	Coated contoured crushable structural members and methods for making the same
32	20050017543	Automotive rail/frame energy management system
33	20050014003	Thermoplastic resin composition and production method thereof
34	20050013983	Sheet, fiber and resin composite material and method and apparatus for forming same
35	20050012424	Multilayer co-extrusion rotor slot armor and system for making the same
36	20050005890	Engine intake manifold assembly
37	20050004296	Pelletized organopolysiloxane material
38	20050003721	Joining of different thermoplastic polymers
39	20050003208	Method of reducing the color contribution of a coated top layer in a multi-layer material
40	20040266927	Filled blends of tubular reactor produced ethylene/alkyl acrylate copolymers modified with organic acids
41	20040263021	MULTILAYER CO-EXTRUSION ROTOR SLOT ARMOR AND SYSTEM FOR MAKING THE SAME
42	20040263020	ROTOR SLOT INSULATION FOR TURBINE-GENERATORS AND METHOD AND SYSTEM OF MANUFACTURE
43	20040262977	Molded article having a rigid support and a flexible hollow member
44	20040260001	Articles from plasticized polyolefin compositions
45	20040259483	Ultrasonic welding method for the manufacture of a polishing pad comprising an optically transmissive region
46	20040254332	ALIPHATIC-AROMATIC POLYETHERESTER COMPOSITIONS, ARTICLES, FILMS, COATING AND LAMINATES AND PROCESSES FOR PRODUCING SAME
47	20040254256	Viscoelastic polyurethanes
48	20040253430	Thermoplastic molding process and apparatus
49	20040253429	Thermoplastic molding process and apparatus
50	20040253428	Weatherable multilayer articles and method for their preparation

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	PUB. APP. NO.	Title
51	20040250944	Composite articles comprising resorcinol arylate polyester and method for making thereof
52	20040249080	Soft touch polyolefin compositions
53	20040249031	Polypropylene resin moldings and process for production thereof
54	20040247856	Sorted composite plastic material and method for the production thereof
55	20040241479	New Backing layers and substrates for articles formed from ionomer laminates
56	20040241420	Methods for manufacturing silver multilayered films and the articles obtained therefrom
57	20040241386	Thermoplastic molding process and apparatus
58	20040238114	Air bag system and method of forming the same
59	20040230001	Toughened polyoxymethylene-poly(lactic acid) compositions
60	20040229533	Layered structure
61	20040225069	Impact-modified compositions and method
62	20040225058	Intimate physical mixtures containing macrocyclic polyester oligomer and filler
63	20040225034	Impact-modified compositions and method
64	20040224177	Surface finishing compression molding with multi-layer extrusion
65	20040224162	Radiation-curable composite layered sheet or film
66	20040224127	Molded article having a rigid support and a flexible hollow member
67	20040222924	Conductive thermoplastic compositions and antennas thereof

68	20040222562	Rapid thermoform pressure forming process and apparatus
69	20040220334	Blends containing macrocyclic polyester oligomer and high molecular weight polymer
70	20040217521	Method of preparing a molded article having a rigid support and a flexible hollow member
71	20040214952	Composition and method for improving the surface adhesion of resin compositions to polyurethane foam
72	20040212220	Automotive rail/frame energy management system
73	20040210056	Water compatible sterically hindered alkoxyamines and hydroxy substituted alkoxyamines
74	20040209057	Extruded polymeric high transparency films
75	20040198893	Container for alkaline solution
76	20040198112	Aquatic gliding board
77	20040197547	Twin-sheet thermoforming process
78	20040194877	Seating system and method of forming same
79	20040194284	Composite part and method for the production thereof
80	20040192847	THERMOPLASTIC COMPOSITION
81	20040191496	Coated microporous sheets
82	20040191447	Method of content protection with durable UV absorbers
83	20040188885	Instrument panel assembly and method of forming same
84	20040188006	Method of manufacturing printed and laminated bed and bed liner
85	20040186214	Fibers and nonwovens from plasticized polyolefin compositions
86	20040185220	Impregnated layered product usable as a soundproofing element in vehicles
87	20040185200	Disposable food contact compatible microwaveable containers having at least one micronodular surface and process for their manufacture
88	20040181005	Impact modified polymer compositions
89	20040180990	Resin molded article
90	20040177941	Method for producing a thermoplastically deformadable, fibre-reinforced semi-finished product
91	20040177563	Microporous polishing pads
92	20040175593	Formable thermoplastic multi-layer laminate, a formed multi-layer laminate, an article, and a method of making an article
93	20040171340	Microporous polishing pads
94	20040171339	Microporous polishing pads
95	20040171338	Microporous polishing pads
96	20040168622	Paintable multifunction components for watercraft
97	20040167264	Impact-strength-modified polymer compositions
98	20040166323	Weatherable multilayer articles and method for their preparation
99	20040166266	Pressurized containers and method for making thereof
100	20040161611	Laminated composite material and method for the production thereof

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	PUB. APP. NO.	Title
101	20040160088	Front end module
102	20040157533	CMP pad with composite transparent window
103	20040152837	Homogeneously colored thermoplastic molding compositions
104	20040152799	Flexible radiation curable compositions
105	20040151889	Process to make a sheet material with cells and voids
106	20040149998	Illumination system using a plurality of light sources
107	20040148696	Fiberglass reinforced fixture with finished polymeric cap
108	20040146714	Laminated molded article
109	20040145095	Method of making a composite molded article
110	20040145094	Method of making a composite molded article
111	20040145093	Method of making a composite molded article
112	20040145092	Method of making a composite molded article
113	20040143969	Baffling, sealing or reinforcement member with thermoset carrier member and method of forming the same
114	20040142176	Weatherable multilayer articles and method for their preparation
115	20040142132	Injection blow-molded disposable tumbler and method of making same
116	20040138350	Stabilized metallocene polyolefins
117	20040137177	Multi-chamber container
118	20040132887	Thermoplastic polymeric ovenware

119	20040129388	Non-marring tire lever
120	20040121114	Methods, systems and compositions for fire retarding substrates
121	20040119202	Embossed indicia on foam core imaging media
122	20040119189	Indicia on foam core support media
123	20040118509	Concentrations to improve surface adhesion characteristics of polyacetal-based compositions
124	20040116603	Polyester compositions for appearance parts
125	20040116583	Styrene polymer composition and molded article obtained therefrom
126	20040116572	Polyethylene terephthalate compositions
127	[illegible]	Method of thermoforming fiber reinforced thermoplastic sandwich panels, thermoformed articles, and modular container structure assembled therefrom
128	[illegible]	Method of producing a thick, thermoformable, fiber-reinforced semi-finished product
129	20040110890	Polyester compositions for appearance parts
130	[illegible]	Unidirectional web made of composite material
131	20040106731	Poly(ester) carbonate molding compositions
132	20040106723	Plasticized polyolefin compositions
133	20040106703	Pigment formulations
134	20040102591	Polymerization of olefins
135	20040101687	Articles of manufacture incorporating polyester/polycarbonate blends
136	20040101678	Thermoplastic article having a decorative material embedded therein
137	20040096683	Modified ethylene-vinyl alcohol copolymer and method for the production thereof
138	20040094486	Use of polymers as filtering aids and/or stabilizers
139	20040092330	Hybrid golf club shaft
140	20040092329	Hybrid golf club shaft
141	[illegible]	PROCESS FOR MAKING GLASS-REINFORCED MULTI-LAYER SHEETS FROM OLEFIN POLYMER MATERIALS
142	20040090380	Electrically conductive patterns, antennas and methods of manufacture
143	[illegible]	POROUS POLYMERIC MEMBRANE TOUGHENED COMPOSITES
144	20040077787	Fabricated articles prepared from blends of substantially random ethylene/propylene/vinyl aromatic interpolymers with polypropylene
145	20040072006	Method of attaching plastic to a metal section and part made thereby
146	20040069972	Corrosion inhibiting composition and article containing it
147	20040068059	Aliphatic polyester copolymer and process for producing the same, biodegradable resin molding based on aliphatic polyester, and lactone-containing resin
148	20040067705	Process of bonding and composites made therefrom
149	20040064163	Contoured battery for implantable medical devices and method of manufacture
150	20040063837	Tarnish inhibiting composition and article containing it

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	PUB. APP. NO.	Title
151	20040062986	Contoured battery for implantable medical devices and method of manufacture
152	20040062985	Contoured battery for implantable medical devices and method of manufacture
153	20040059035	Plastic shipping and storage containers and composition and method therefore
154	20040059010	Composite foam made from polymer microspheres reinforced with long fibers
155	20040058182	Glass preform with living hinge
156	20040058175	Layered composite sheet or layered composite film
157	20040058141	Powder coating systems
158	20040058092	Liquid crystalline polymers, processes for their manufacture, and articles thereof
159	20040055705	Hybrid spray booth for powder coating systems
160	20040053001	Process for printing and molding a flocked article
161	20040051212	Moldable preform with B-stage thermoset polymer powder binder
162	20040044134	METHOD TO MAKE A SOLID POLYMERIC PHOSPHATE AND RESINOUS COMPOSITIONS CONTAINING IT
163	20040044119	Pigmentation formulations
164	20040044105	METHOD FOR IMPROVING FIBER DISPERSION AND ORIENTATION IN LET-DOWNS OF LONG FIBER REINFORCED COMPOSITES
165	20040041429	Composite panel and method of forming the same
166	20040039108	Elastomer composition containing a softening agent
167	20040036658	Bodywork part with integrated antenna

168	20040036302	Pedestrian energy absorber for automotive vehicles
169	20040034140	Thermoplastic resin composition, molded product using the same and transport member for electric and electronic parts using the same
170	20040034132	Flame retardant resinous compositions and method
171	20040033355	String binders
172	20040032156	Furniture with molded frame
173	20040028907	Weatherable multilayer articles and method for their preparation
174	20040028858	Composite component and process for its production
175	20040028826	Process for coating to obtain special surface effects
176	20040024102	Sulfonated aliphatic-aromatic polyetherester films, coatings, and laminates
177	20040024101	Sulfonated aliphatic-aromatic copolyetheresters
178	20040022977	Injection blow-molded disposable tumbler and method of making same
179	20040018350	Sheet, fiber and resin composite material and method and apparatus for forming same
180	20040011362	Crush resistant filtering face mask
181	20040009338	Plastic rail system and other building products reinforced with polymer matrix composites
182	20040006164	Intumescent fire retardant polymeric composition
183	20030236352	Polyolefin compositions and method of use thereof in molded products
184	20030236350	Impact-modified compositions
185	20030232176	Thermoplastic molding process and apparatus
186	20030232112	Packaging system assembly for carry-out food
187	20030229180	Disposable bakeware with improved drip resistance at elevated temperatures
188	20030225221	High performance thermoplastic compositions with improved melt flow properties
189	20030220061	Microporous polishing pads
190	20030219663	Imaging member with amorphous hydrocarbon resin
191	20030219646	Carbon fiber reinforced plastic bipolar plates with continuous electrical pathways
192	20030215956	Multi-well microfiltration apparatus
193	20030213939	Electrically conductive polymeric foams and elastomers and methods of manufacture thereof
194	20030211344	Method and composition for electrostatic coating, and articles made therefrom
195	20030211311	Integrated co-injection molded vehicle components and methods of making the same
196	20030207984	Ionomeric nanocomposites and articles therefrom
197	20030207123	Weatherable, thermostable polymers having improved flow composition
198	20030207116	Sandwich elements and the use thereof
199	20030207096	Weatherable multilayer resinous articles and method for their prepartion
200	20030206928	BIOACTIVE, BIOABSORBABLE SURGICAL POLYETHYLENE GLYCOL AND POLYBUTYLENE TEREPHTALATE COPOLYMER COMPOSITES AND DEVICES

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	PUB. APP. NO.	Title
201	20030205852	Polyester compositions
202	20030205339	Tubular slat for covering for architectural openings
203	20030204019	Engineered polyolefin materials with enhanced surface durability
204	20030203184	Process to make a sheet material with cells and voids
205	20030200714	High performance door
206	20030193105	Molding tool construction and molding method
207	20030193045	Flame retardant treating agents, flame retardant treating process and flame retardant treated articles
208	20030190443	Thermoformed food containers with colorfast high color density black pigment
209	20030185039	Foamed polypropylene resin sheet
210	20030183979	Mixing device and methods for producing thermoplatically processable moulding materials, especially additive batches
211	20030183317	Structurally reinforced members
212	20030181603	Resinous compositions, method of manufacture thereof and articles fabricated from the composition
213	20030181583	Method for agglomerating dispersed rubber
214	20030181261	Golf ball with a layer including composite material and a method for making such a golf ball
215	20030180542	Thermally stable polymers, method of preparation, and articles made therefrom
216	20030176613	Textile structures comprising organopolysiloxane polyurea-polyurethane block

	copolymer
217 20030175488	Multilayer articles comprising resorcinol arylate polyester and method for making thereof
218 20030173366	Disposable food container with a linear sidewall profile and an arcuate outer flange
219 20030171508	Alpha-olefins and olefin polymers and processes therefor
220 20030170450	Attachment of surface mount devices to printed circuit boards using a thermoplastic adhesive
221 20030170444	Attachment of surface mount devices to printed circuit boards using a thermoplastic adhesive
222 20030166764	Method of prepregging with resin and novel prepregs produced by such method
223 20030162900	Impact-resistant modified polyamide molding compositions with higher melt viscosity and improved surface quality
224 20030162852	Acoustical insulation foams
225 20030162001	Multilayered composite body consisting of leather and thermoplastic elastomers
226 20030155694	Post formation profile processing
227 20030155685	Molding method and apparatus with plural cooperating mold tools for forming interior trim components for motor vehicles
228 20030152760	Imaging element having improved crack propagation during conversion
229 20030150854	Disposable, microwaveable containers having suitable food contact compatible olfactory properties and process for their manufacture
230 20030148093	Multilayered article
231 20030144422	Novel degradable polymers
232 20030144389	Method of content protection with durable UV absorbers
233 20030141609	Method for momentarily heating the surface of a mold and system thereof
234 20030141297	Thermoformed polypropylene mineral-filled microwaveable containers having food contact compatible olfactory properties and process for their manufacture
235 20030139504	Flame retardant resinous compositions and method
236 20030138655	Wiper blade
237 20030132657	Molded article having a rigid support and a flexible hollow member
238 20030130420	Polyolefin powder, processes for making and using slush molded articles made from the same
239 20030129376	Imaging element having improved crack propagation during conversion
240 20030125478	HIGH PERFORMANCE THERMOPLASTIC COMPOSITIONS WITH IMPROVED MELT FLOW PROPERTIES
241 20030125430	Transparent, flame retardant poly(arylene ether) blends
242 20030124254	Wet on wet process for producing films
243 20030120077	Hydroxy substituted N-alkoxy hindered amines and compositions stabilized therewith
244 20030119986	ABS compositions with improved property combinations
245 20030119950	Method of content protection with durable UV absorbers
246 20030114563	Impact-resistant poly(ester)carbonate composition
247 20030109650	Flame retardant resinous compositions and method
248 20030108700	Plastic shipping and storage containers and composition and method therefore

249 20030105225 Thermoplastic molding compounds with improved impact resistance

250 20030100635 Biodegradable starch resin and method for making same

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251	20030092837	ABS compositions having improved combinations of properties
252	20030090129	Automotive rail/frame energy management system
253	20030088026	Thermoplastic resin composition
254	20030083498	Hindered amine light stabilizers based on multi-functional carbonyl compounds and methods of making same
255	20030073773	Impact-modified polymer compositions
256	20030072956	Laminate
257	20030072945	Thermally stable polymers, method of preparation, and articles made therefrom
258	20030055188	Novel phosphorus-containing monomers and flame retardant high impact monovinylidene aromatic polymer compositions derived therefrom
259	20030054187	Laminate
260	20030050400	METHOD FOR PREPARING COPOLYESTERCARBONATES AND ARTICLES THEREFROM
261	20030049451	Method and compositions for electrostatic painting, and articles made therefrom
262	20030045640	Oxygen scavenging high barrier polyamide compositions for packaging applications
263	20030040577	Polypropylene graft copolymer/fluorinated polyolefin blends
264	20030039839	Decorative film for use in plastics molding, process for preparing the same and injection-molded part by use of the same
265	20030038075	Hollow yarn membrane module, hollow yarn membrane module unit, and method of producing hollow yarn membrane modules

266 20030036602 Poly(arylene ether)-polyolefin composition, method for the preparation thereof, and articles derived therefrom

267 20030035917 Image making medium

268 20030031847 Process of making a glossy film

269 20030030172 Formed decorative film

270 20030022952 Flexible polyolefin compounds for vehicle applications

271 20030022009 Layered composite material with an intermediate layer made from a thermoplastic

272 20030021915 Cellulose - polymer composites and related manufacturing methods

273 20030008105 Metal-plastic composite made from long-fiber-reinforced thermoplastics

274 20030004276 Polymer blends of polypropylene and ethylene-octene copolymers, method of blending, products made therefrom, and method of making products

275 20030004268 Polyimide blends, method of making, and articles made therefrom

276 20020190440 Method for vacuum pressure forming reinforced plastic articles

277 20020182389 Heat-absorbing layer system

278 20020179520 Multi-well microfiltration apparatus

279 20020179170 Channel for an automobile fluid

280 20020175171 Sealable food container with lid retaining sidewall shelf

281 20020173590 LOW-GLOSS BLENDS CONTAINING POLY(METH)ACRYLATE RUBBER-BASED GRAFT COPOLYMER AND PROCESS FOR MAKING THEREOF

282 20020172017 Functional enclosure for a personal electronic device

283 20020170662 Twin-wall composite sheet

284 20020168503 Decorative and/or flame retardant laminates and/or polyolefin laminates and processes of manufacture thereof

285 20020165317 Reinforced thermoplastic composition and articles derived therefrom

286 20020161156 COPOLYMERS OF HIGH VINYLIDENE POLYOLEFINS WITH VINYL OR VINYLIDENE MONOMERS PRODUCED BY FREE RADICAL POLYMERIZATION

287 20020161075 Polymeric articles containing hindered amine light stabilizers based on multi-functional carbonyl compounds

288 20020156229 Thermally stable polymers, method of preparation, and articles made therefrom

289 20020156165 Polyolefin articles with long-term elevated temperature stability

290 20020151233 Subassembly designed to produce an aquatic gliding board

291 20020150748 Surface finishing compression molding with multi-layer extrusion

292 20020147261 Impact-modified polycarbonate compositions

293 20020137822 Flame-resistant, mineral-reinforced polycarbonate compositions with a high flow line strength

294 20020136916 Elastic films made from alpha-olefin/vinyl aromatic and/or aliphatic or cycloaliphatic vinyl or vinylidene

295 20020136862 Decorative and/or flame retardant laminates and processes of manufacture thereof

296 20020135519 Electrically conductive patterns, antennas and methods of manufacture

297 20020132905 Compositions of interpolymers of alpha-olefin monomers with one or more vinyl or vinylidene aromatic monomers and/or one or more hindered aliphatic or cycloaliphatic vinyl or vinylidene monomers blended with a conductive additive

298 20020132548 WET-LAID NONWOVEN WEB FROM UNPULPED NATURAL FIBERS AND COMPOSITE CONTAINING SAME

299 20020128391 Resin composition and multilayered structure

300 20020122907 Sealable food container with improved lidding and stacking features

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	PUB. APP. NO.	Title
301	20020121717	Acoustical insulation foams
302	20020121223	Copolymer, adhesive containing the same and laminate
303	20020120076	Free flowing polyester molding composition
304	20020120044	Flame retardant polycarbonate resin/ABS graft copolymer blends
305	20020119719	Engineering thermoplastic polyurethane reinforced with glass mat
306	20020117873	PICKUP TRUCK BOX
307	20020113694	High performance fuel tank
308	20020113118	Deep dish disposable container
309	20020111427	Thermoplastic containers having high dimensional stability
310	20020111409	Polyester compositions having improved color stability
311	20020111405	Flame retardant polycarbonate resin/ABS graft copolymer blends
312	20020108725	Bulkhead and partition systems
313	20020106483	Modified contoured crushable structural members and methods for making the same
314	20020106468	Shaped contoured crushable structural members and methods for making the same
315	20020103295	Thermoplastic molding compositions
316	20020099218	Hindered amine light stabilizers based on multi-functional carbonyl compounds and methods of making same
317	20020099125	Oxygen scavenging high barrier polyamide compositions for packaging applications
318	20020094398	Extruded multilayer polymeric shell having textured and marbled surface

319 20020037000 Oligomeric hindered amine light stabilizers based on multi-functional carbonyl compounds and methods of making same

320 20020082346 Thermoplastic compositions having high dimensional stability

321 20020031920 Contoured composite structural members and methods for making the same

322 20020062546 Coated contoured crushable structural members and methods for making the same

323 20020061976 Propylene polymer composition

324 20020058735 Hydroxy-substituted N-alkoxy hindered amines and compositions stabilized therewith

325 20020055586 THERMOPLASTIC COMPOSITIONS HAVING HIGH DIMENSIONAL STABILITY

326 20020055006 Multilayer, co-extruded, ionomeric decorative surfacing

327 20020052429 Functional liquid-solid additive systems: compositions, processes, and products thereof

328 20020045685 Thermoplastic compositions of interpolymers of alpha-olefin monomers with one or more vinyl or vinylidene aromatic monomers and/or one or more hindered aliphatic or cycloaliphatic vinyl or vinylidene monomers blended with engineering thermoplastics

329 20020045681 High solids polymeric additive systems: compositions, processes, and products thereof

330 20020045680 Multiple polymeric additive systems: compositions, processes, and products thereof

331 20020045056 Process for producing laminated sheets or films and moldings having UV-stability and thermal aging resistance

332 20020043654 Electrically conductive thermoplastic elastomer and product made thereof

333 20020040120 Novel phosphorus-containing monomers and flame retardant high impact monovinylidene aromatic polymer compositions derived therefrom

334 20020040090 Thermoplastic resin composition, molded product using the same and transport member for electric and electronic parts using the same

335 20020040074 Dental materials containing a tear-off material

336 20020039657 Thermally stable polymers, method of preparation, and articles, made therefrom

337 20020037378 Disposable serving plate with sidewall-engaged sealing cover

338 20020035206 Resin composition and resin moldings using the same

339 20020035176 Flame retardant, high impact monovinylidene aromatic polymer composition

340 20020032253 THERMOPLASTIC COMPOSITE MATERIAL

341 20020028868 THERMOPLASTIC RESIN COMPOSITION

342 20020028861 Method of content protection with durable UV absorbers

343 20020025099 Color stable compositions containing arylate-comprising polymers

344 20020025420 Acrylic polymer capstock with improved adhesion to structural plastics

345 20020019466 Method to prepare phosphoramides, and resin compositions containing them

346 20020014022 Athletic shoe midsole design and construction

347 20020012806 Thermoplastic multilayer composites

348 20020011047 Contoured crushable composite structural members and methods for making the same

349 20020010283 NOVEL ARYL ESTER COMPOUND, ITS PRODUCTION PROCESS, EPOXY RESIN COMPOSITION USING SAID COMPOUND, AND COPPER-CLAD

LAMINATE USING THE EPOXY RESIN COMPOSITION

350 20020010238 Ignition resistant polymer compositions

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	PUB. APP. NO.	Title
351	20020009936	Method for fabricating non-fiberglass sound absorbing moldable thermoplastic structure
352	20020007903	Extrusion coating process for making high transparency protective and decorative films
353	20020006755	Method and apparatus for fabricating chopped fiberglass laminate for automotive headliners
354	20020006523	Structural members containing vibration damping mechanisms and methods for making the same
355	20020004542	Ignition resistant monovinylidene aromatic copolymer composition
356	20020001730	Multilayer structure with acrylic cap layer, polyolefin core layer, and intermediate tie layer
357	20020001729	Multilayer composite structure with formulated acrylic cap
358	20010055671	Weatherable multilayer articles and method for their preparation
359	20010053819	Flame retardant anti-drip polyamide compositions
360	20010053454	Laminated film and structure comprising same
361	20010052385	Extruded polymeric high transparency films
362	20010048175	Process for in-line forming of pultruded composites
363	20010047844	Composites of reinforcing fibers and thermoplastic resins as external structural supports
364	20010038225	Hard truck bed cover
365	20010036788	Vehicle headliner and laminate therefor
366	20010036559	Metal-plastic composite made from long-fiber-reinforced thermoplastics

367	20010035596	Increasing the elongation at break of moldings
368	20010033919	Layered composite materials with a decorative layer made from a chromed metal
369	20010033041	Process for producing resin molded article
370	20010032842	Disposable, microwaveable containers having suitable food contact compatible olfactory properties and process for their manufacture
371	20010031804	Color stable compositions containing arylate-comprising polymers
372	20010023568	Reinforcing bars for concrete structures
373	20010021734	Color stable compositions containing arylate-comprising polymers
374	20010018306	Vacuum formed coated fibrous mat and laminate structures made therefrom
375	20010018105	Multilayer plastic pipe with good layer adhesion
376	20010017301	Inner container for household devices
377	20010016627	MELT TENSION IMPROVER FOR POLYOLEFIN RESINS AND PROCESS FOR PRODUCING THE SAME
378	20010015354	Thermoformed polypropylene mineral-filled microwaveable containers having food contact compatible olfactory properties and process for their manufacture
379	20010011573	Polyurethane foam/PVC laminate for automotive instrument panels
380	20010009946	POLYCARBONATE RESIN/GRAFT COPOLYMER BLENDS
381	20010005965	Reinforced exterior siding
382	20010000258	Articles made from polypropylene, higher alpha-olefin copolymers

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United States Patent [19]

Smith et al.

[11] **Patent Number: 4,948,661**

[45] **Date of Patent: Aug. 14, 1990**

[54] **GLOSSY FINISH FIBER REINFORCED MOLDED PRODUCT AND PROCESSES OF CONSTRUCTION**

[75] Inventors: **Rayna W. Smith, Harrisburg, Pa.; Gerald W. Miller, Cincinnati, Ohio**

[73] Assignee: **C. H. Masland & Sons, Carlisle, Pa.**

[21] Appl. No.: **314,896**

[22] Filed: **Feb. 24, 1989**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 71,969, Jul. 10, 1987.

[51] Int. Cl.[5] B29C 51/02; B29C 51/14; B32B 31/20; B32B 33/00

[52] U.S. Cl. 428/286; 156/182; 156/205; 156/222; 156/224; 156/245; 156/288; 156/308.2; 264/112; 264/119; 264/122; 264/257; 264/258; 264/294; 264/320; 264/331.17; 264/331.19; 264/331.21; 264/DIG. 64; 264/DIG. 66; 264/DIG. 75; 264/DIG. 76; 428/34.5; 428/34.7; 428/36.1; 428/182; 428/184; 428/287; 428/288; 428/296; 428/409

[58] Field of Search ..... 156/182, 205, 222, 224, 156/245, 288, 308.2; 264/112, 119, 122, 257, 258, 294, 320, 331.17, 331.19, 331.21, DIG. 64, DIG. 66, DIG. 75, DIG. 76; 428/182, 184, 286, 287, 288, 296, 409

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Primary Examiner—James C. Cannon
Attorney, Agent, or Firm—Nixon & Vanderhye

[57] **ABSTRACT**

Fiber reinforced thermoplastic molded products, sheets, and the like, having a glossy surface are produced by intimately blending discrete reinforcing fibers (e.g. fiberglass) and thermoplastic fibers (e.g. polypropylene or polycarbonate) into a web. The web is heated to the melting point of the thermoplastic fibers while applying pressure, to eliminate air and press the web into a consolidated structure. Breakage of the reinforcing fibers is minimized by limiting the thickness of the web and limiting the pressure so as to produce a consolidated structure with minimal fiber breakage and a Notched Izod of at least one. Layering consolidated structures, some without reinforcing fibers, may be heated and pressed together to form a final structure having a thickness greater than the individual structures. The great majority of the fibers are provided so that the fibers of each type are within the range of about 0.5–5 inches. A sheet capable of replacing an automotive metal panel (that is having sufficiently high gloss, rigidity and impact characteristics) is provided, the sheet having a Notched Izod of at least about two and preferably at least about five. Products with Notched Izods of up to eight or nine may be achieved.

22 Claims, 1 Drawing Sheet

FIG. 1

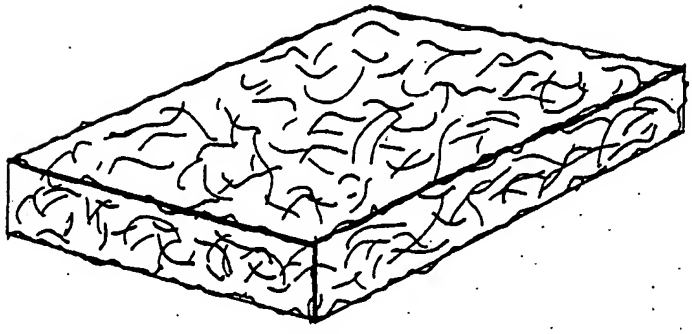


FIG. 2

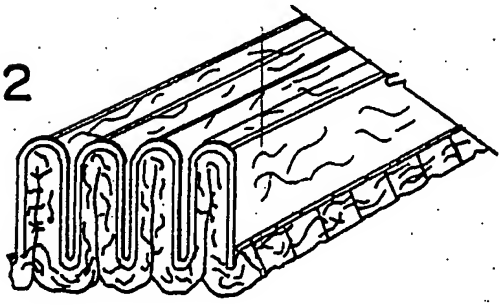


FIG. 3

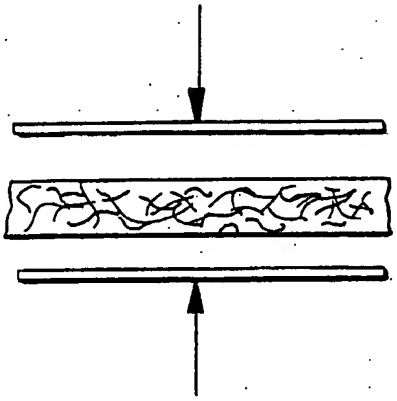
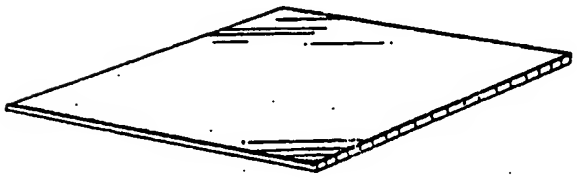


FIG. 4



GLOSSY FINISH FIBER REINFORCED MOLDED PRODUCT AND PROCESSES OF CONSTRUCTION

This application is a continuation-in part of application Ser. No. 07/071,969, filed July 10, 1987.

FIELD OF THE INVENTION

This invention relates to reinforced thermoplastic molding materials in which the reinforcement is impregnated with a thermoplastic.

BACKGROUND OF THE INVENTION

Reinforced plastic materials, particularly fiber-reinforced plastic materials, have been prepared by various procedures in which the plastic is pre-impregnated into a fibrous reinforcement. The plastic used as the continuous phase is usually of the thermoset type with chopped or relatively short reinforcing fibers distributed uniformly in the plastic matrix. A limited number of thermoplastic-based reinforced systems are known, for instance, as a liquid plastic added to a fibrous bat or in a film stacking process in which alternating layers of fibrous reinforcement and thermoplastic film are plied one atop the other then consolidated with heat and pressure to form a consolidated laminated article.

To the best of our knowledge, a fiber reinforced thermoplastic prepreg material containing a substantial, functionally significant amount of long fiber reinforcement presenting a smooth, glossy, cosmetically attractive surface has not been described by a thermoforming process. The thermoplastic properties of the prepreg material allow forming and processing procedures not possible with thermosetting reinforced materials. The fiber reinforced thermoplastic prepreg materials of this invention may be thermoformed into a final shape with heat and pressure in a single step or previously consolidated prepregs may be heated and formed in conventional (unheated) metal forming presses.

SUMMARY OF THE INVENTION

The invention particularly relates to, though it is not limited to in all respects, smooth, glossy finished fiber reinforced thermoplastic prepreg materials composed of reinforcement fibers impregnated with and surrounded by thermoplastic. Prior to consolidation, the material preferably consists of thermoplastic fibers and reinforcing fibers, intimately blended together. When heated, with the aid of pressure, the thermoplastic fibers melt, surround and impregnate the reinforcing fibers and provide a smooth, glossy finish to the reinforced article. Excellent surface appearance, appropriate mechanical properties, and the ability to accommodate high-speed processing characterize the prepreg materials of this invention.

According to one aspect of the invention, there is provided a process of preparing a fiber reinforced thermoplastic molded product having a glossy surface. The process comprises the steps of: (a) Blending discrete reinforcing fibers and thermoplastic fibers to provide a uniformly blended distribution, and forming the blended fibers into a web. (b) Heating the web to at least the melting point of the thermoplastic fibers and applying pressure to the web to cause the thermoplastic fibers to melt, to eliminate air from the web and to press the web into a consolidated structure. And, (c) minimizing breakage of the reinforcing fibers during the practice of step (b) by limiting the thickness of the web subjected to heat and pressure, and limiting the pressure, so as to produce a consolidated structure with minimal fiber breakage and a Notched Izod of at least one.

The reinforced fibers comprise fiber bundles of fiberglass which have been opened into discrete staple filaments.

According to another aspect of the present invention there is a process for preparing a fiber reinforced thermoplastic product having a glossy surface. The process comprises the steps of: (a) Providing reinforcing fiber in discrete staple form (e.g. by opening up fiber bundles of a reinforcing fiber to form discrete staple filaments). (b) Providing thermoplastic fiber in discrete staple form (e.g. by opening up the fiber bundles of a thermoplastic fiber to form discrete staple filaments). (c) Practicing steps (a) and (b) so that the length of the great majority of fibers of each type is within the range of about 0.5–5 inches. (d) Intimately blending the discrete reinforcing and thermoplastic fibers into a web. And, (e) heating the web to at least the melting point of the thermoplastic fibers and applying pressure to the web to cause the thermoplastic fibers to melt to eliminate air from the web and press the web into a consolidated product. The web optionally can be corrugated prior to step (e).

Consolidated fiber reinforced molded sheets and three dimensional objects having a glossy surface at least in excess of 20 at 20°, preferably in the range of 40 to 60 at 20° measurement, are consistently obtained. Unconsolidated fibrous webs of blended discrete reinforcing fibers and discrete thermoplastic fibers having a melt index of from 5 to about 100 and the molded products consolidated from such webs also may be utilized in the practice of the invention.

The glossy finish fiber reinforced molded product is made from a fiber reinforced thermoplastic prepreg using various procedures. According to a first embodiment, a thermoplastic fiber of any particular type, preferably having a melt index in the range of 30 to 50, is blended with a reinforcement fiber until the fibers are uniformly distributed.

Following intimate mixing, the fibers may be formed into a web in a number of ways. For example, they may be laid into a fiber mat or web on air-lay equipment with the fiber pattern or orientation determined by the air-laying equipment. Other ways of making the basic mat include using carded and cross-laid equipment, and good opening and chute feed batt forming equipment.

The blended fibers, corrugated or otherwise, are placed in a press maintained above the melting point of the thermoplastic fiber, the press is closed and the fiber mass is subjected to pressure, for instance 10 psi, for a brief period of time in order to cause the thermoplastic fibers to melt, spread evenly throughout and uniformly impregnate the reinforcement fiber mass and to form a smooth, glossy coherent surface on both faces of the shaped article.

The blended fiber webs or corrugated webs may be formed into three dimensional objects with heat and pressure or consolidated into flat sheets or rolls as flat stock for later pressing and forming operations. Consolidated sheets have a considerably smaller volume and are more convenient to handle than the fibrous webs.

Thermoplastic prepregs are readily formed into three dimensional objects in conventional metal forming equipment using known fabricating techniques, and as such may be used in conventionally available metal working equipment, for instance by heating the thermoplastic prepreg external of the press, then quickly pressing in a press designed primarily for metal forming and fabricating. Because the prepreg is thermoplastic, excess materials or pressed articles not meeting the standard desired may be heated and remelted without significant loss of material.

The smooth, mirror-like surface achieved by the process qualifies as a "Class A" surface. This high quality, smooth surface is achieved because the separated and discrete thermoplastic filaments provide a uniform, non-centralized flow of thermoplastic throughout the fiber reinforced mass, thus intimate blending and thorough intermixing of the thermoplastic fibers with the reinforcing fibers is essential to achieving a smooth, mirror-like surface. Because the fibers are discrete instead of bundled, a smooth surface finish can be obtained.

The intimately blended reinforcing and thermoplastic fibrous web is preferably prepared as follows: Staple fiber (both thermoplastic and reinforcing) is taken from a bale, weighed, the individual fiber bundles opened and blended. The staple fiber for both the reinforcement (fiberglass, carbon, aramid) fibers and the thermoplastic (polypropylene, polyester, nylon) fibers are used in combination and are intimately blended together.

The blend is processed on conventional textile equipment which opens the fiber bundles into discrete fibers and blends the reinforcement and resin fibers together. The fiber blend is preferably processed on textile air laying equipment which reduces breakage of the fibers (it is useful to maintain a high length to diameter ratio of the reinforcing fibers) and produces a web ranging from about 5 to 10 ounces per square yard.

It has also been found according to the present invention that the length of fibers plays a part in determining how successfully a glossy surface fiber reinforced thermoplastic product can be produced. In a typical practice of the invention, fiber bundles of a reinforcing fiber are opened up to form discrete staple filaments, and similarly fiber bundles of a thermoplastic fiber are opened to form discrete staple filaments. These steps are practiced so that the length of the great majority of the fibers of each type is within the range of about 0.5–5 inches. The fibers are then intimately blended together, and heated under pressure to cause the thermoplastic fibers to melt while eliminating air, and while pressing the web into a consolidated product. The typical length of glass reinforcing fibers that is utilized is at least 0.5 inches to several inches. The upper limit would be presumed from the inability to mix very short fibers with very long fibers. Fiber diameters in excess of 0.020 inches would not be desirable for the organic fiber portion due to difficulties in intimate mixing. Glass fibers (or like reinforcing fibers) are usually less than 0.001 inches in diameter. In general, the length and diameter characteristics of the fibers must be such to ensure intimate mixing of the fibers in order to get a class A type surface and good physical properties for structural use.

Various examples which show the aspects of the present invention described above are as follows:

EXAMPLE 1

Thermoplastic polypropylene fibers (Amoco, type 10, color 1312) and reinforcing glass fibers (Owens Corning Fiberglas, type 700, H-filament) were individually separated into discrete fibers, followed by intimately blending in a 70/30 (by weight) thermoplastic/glass fiber ratio. The blend was processed on air laying equipment (Rando Webber Model #458, #RWP 792) to produce a web in the range of 5–10 oz./sq. yd., and a width of forty inches and a thickness of slightly less than 1 inch.

US006054022A

United States Patent [19]

Helwig et al.

[11] Patent Number: 6,054,022

[45] Date of Patent: Apr. 25, 2000

[54] **METHOD FOR PRODUCING A NON-WOVEN GLASS FIBER MAT COMPRISING BUNDLES OF FIBERS**

[75] Inventors: **Gregory S. Helwig**, Granville, Ohio; **Vallipuram Pathmanathan**, Bradford; **Robert W. Heseltine**, Guideley, both of United Kingdom

[73] Assignees: **Owens-Corning Veil U.K. Ltd.**, Liversedge, United Kingdom; **Owens Corning Fiberglas Technology, Inc.**, Summit, Ill.

[21] Appl. No.: 09/036,519

[22] Filed: Mar. 6, 1998

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/712,711, Sep. 12, 1996, abandoned.

[51] Int. Cl.[7] D21H 13/38

[52] U.S. Cl. 162/156; 162/158; 162/164.1; 162/164.3; 162/168.3; 162/177

[58] Field of Search 162/156, 158, 162/145, 179, 177, 178, 168.1, 168.3, 100, 164.1, 164.3

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Primary Examiner—Peter Chin

Attorney, Agent, or Firm—Inger H. Eckert

[57] ABSTRACT

A method is provided for forming a wet-laid nonwoven glass fiber mat comprised of a plurality of bundles of fibers. The method includes the steps of adding chopped fibers to a water slurry containing a sufficient amount of a suitable hydrophobic agent to cause the fibers to form a plurality of bundles. The fibers are then formed into a mat which may be used in a number of reinforcement applications. A method is also provided for modifying the components in the water slurry to produce mats comprising either bundles of fibers or dispersed fibers.

31 Claims, 2 Drawing Sheets

In addition, the use of dry-chopped input fibers is more expensive than the use of wet-chopped input fibers because the fibers in a dry-laid process are dried and packaged in separate steps before being chopped offline, while wet-chopped fibers are applied with sizing and then chopped directly.

For certain reinforcement applications in the formation of molded parts using polymer resins, it would be desirable to form fiber mats in which the mat comprises bundles of fibers (as in a dry-laid process) and yet has a uniform weight.

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United States Patent [19]

Motsinger et al.

[11] **Patent Number: 4,461,804**

[45] **Date of Patent: Jul. 24, 1984**

[54] **AQUEOUS SIZING COMPOSITION FOR GLASS FIBERS FOR USE IN PRODUCING A MAT**

[75] Inventors: **Donald L. Motsinger, Forest City; Daniel G. Brown, Caroleen, both of N.C.**

[73] Assignee: **PPG Industries, Inc., Pittsburgh, Pa.**

[21] Appl. No.: **268,542**

[22] Filed: **May 29, 1981**

[51] Int. Cl.³ **D04H 1/58; B32B 9/00; C09K 3/00; C03C 25/02**

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[58] Field of Search 106/211, 287.23, 213; 65/3.1, 3.43, 3.44; 428/378, 288, 391, 392, 361; 523/214, 217; 162/156

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[57] **ABSTRACT**

An aqueous sizing composition with a cationic lubricant, amide compound, and water soluble or dispersible polyol which is used to produce wet chopped sized glass fiber strands. The sized wet or dried chopped glass fiber strands can be used to produce non-woven glass fiber strand mat, having good tensile strength, and good flexibility and reduced tendency for static generation. The wet chopped glass fiber strands also have good flowability in bulk handling apparatus.

23 Claims, No Drawings

AQUEOUS SIZING COMPOSITION FOR GLASS FIBERS FOR USE IN PRODUCING A MAT

The present invention is directed to an aqueous sizing composition for treating glass fibers and the treated glass fibers where the treated glass fibers are to be used in producing glass fiber mat.

More particularly, the present invention is directed to an aqueous sizing composition for treating glass fibers and the treated glass fibers that are used for producing glass fiber strand mat having good tensile strength and flexibility.

The production of glass fibers from molten glass involves attenuating fibers from small orifices in a bushing in a glass melting furnace. As the glass fibers are attenuated, but usually before they are gathered into one or more strands, an aqueous sizing composition is applied to them. The aqueous sizing composition is necessary to provide protection to the fibers from interfilament abrasion. Also, the sizing composition can be used to promote compatibility between the glass fibers and any matrix in which the glass fibers are to be used for reinforcement purposes. In the production of glass fibers, after the sizing is applied, the fibers can be gathered into one or more strands and wound into a package or chopped while wet and collected. The collected continuous strands or chopped strands can then be dried or the wet chopped strands can be packaged in their wet condition. Such steps depend upon the ultimate use of the glass fibers. The dried continuous glass fibers can be subsequently chopped or combined with other glass fiber strands to form a roving or produced into continuous strand mats or woven.

It is an object of the present invention to provide an aqueous sizing composition for glass fibers that are manufactured by the wet chopped forming process to yield wet chopped glass fiber strands having good flowability especially in bulk handling machinery.

It is a further object of the present invention to provide wet chopped glass fiber strands that have sufficient flowability in bulk handling machinery.

The aqueous sizing composition is applied to glass fibers in any suitable glass fiber forming process including the wet chop and continuous strand forming process. When the continuous strand forming process is used, the aqueous sizing composition must also have a starch or polyvinylacetate film former used in conventional amounts. Such amounts would increase the overall solids of the size. The sized wet chopped glass fiber strands or dry chopped continuous strands can be used to produce a non-woven glass fiber strand mat by any process similar to the "wet-laid" process on any type of suitable machinery to produce a non-woven glass fiber strand mat with good tensile strength and with good flexibility and with reduced tendency to accumulate static chargrs.

In accordance with the present invention, the flowability of the wet chopped glass fiber strand is achieved only when the chopped glass fibers have been produced by a wet chop glass fiber forming process. The production of a flexible mat of glass fiber strand is achieved by wet or dry chopped glass fiber strand produced by the present invention.

The glass fibers can be cut as individual fibers or they can be gathered into one or more strands and subsequently cut. The cut glass fibers or glass fiber strands are then collected as wet chopped glass fiber strands. Any other suitable wet chopped glass fiber forming process can be used when the aqueous sizing composition of the present invention is applied to the glass fibers. The control of the moisture content between the range of at least 9 and 20 and preferably 10–15 weight percent is crucial for the flowability of the wet chopped glass fiber strands. It is believed without limiting the invention that it is the moisture content and the uniformity of the moisture content that enables the wet chopped glass fiber strands to have good flowability properties.

The wet chopped glass fiber strands can be used in producing non-woven glass fiber strand mat. There is no absolute fiber length for a given glass fiber diameter in the production of non-woven glass fiber strand mat but generally the chopped strands having a length of around ½ inch to 4 inches can be used. As the lengths increase, the fiber diameters can also increase and mixtures of various lengths and various diameter glass fiber strands can be used. The wet chopped glass fiber strands in any suitable length and diameter can be used for producing non-woven glass fiber strand mat. This invention can be carried out by employing any glass fibers conventionally employed to form glass mats. Preferably, the glass fibers will have a diameter within the range of about 3 to 27 microns and will have a length of about ½ inch to 3 inches.

The wet chopped glass fiber strands can be formed into a non-woven glass fiber strand mat by any suitable process known to those skilled in the art.